Assessing Prepay Water Metering in the Informal Settlements of Windhoek

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ASSESSING PREPAY WATER METERING IN THE INFORMAL SETTLEMENTS OF WINDHOEK

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Executive Summary

As the driest country in sub-Saharan Africa, Namibia faces great challenges with respect to water resource management. The cost to collect and distribute water to the residents of the City of Windhoek is extremely high, as water must be piped in from dams and rivers over 400km away. In order to recover costs to support this expensive infrastructure, it is necessary to charge for water consumption. Currently, water pricing in Windhoek is based on an increasing block tariff system in which the lowest consumption block is subsidized by the highest. The lowest block provides for the minimum amount of water necessary to sustain life.

Windhoek's informal settlements are inhabited mostly by rural Namibians who moved to the northern side of the City after independence. The majority of these citizens are unemployed and live below the poverty line of one US dollar per day. The houses in these settlements are made from corrugated iron, and it is standard for a family of five or more to live in a one room structure.

There currently exist two different water metering schemes in the informal settlements: post-pay metering and prepay metering. The majority of communities use the post-pay system where communal standpipes freely dispense water, and one bill is calculated at the end of the month. Community leaders are given this bill for the consumption of the entire community, and it is divided among community members, regardless of their individual water consumption. A significant problem arises with this system since a large majority of residents do not pay their portion of the bill and the rest of the community must pay extra to make up the shortfall.

Using an alternative system of payment, the Department of Infrastructure, Water, and Technical Services of the City of Windhoek has recently implemented a pilot program of prepay metering in the settlements. With the prepay metering system, each household receives a prepay card that must be inserted into the meter in order to dispense water. Prepay users can add credit to their card at one of the two point of sale (POS) locations in the settlements. Although this system ensures that each household only pays for the water it consumes, the system has its own associated problems. Of particular concern is if a resident runs out of credit on the card, he or she will be unable to obtain water from the standpipe.

Our project, sponsored by the Department of Infrastructure, Water, and Technical Services of the City of Windhoek, investigates the advantages and disadvantages associated with the two different metering systems and recommends improvements. To accomplish this goal we established a set of objectives aimed to assess the merits of both metering systems based upon feedback from their users. To complete the objectives discussed below, we analyzed opinion data gathered from both professionals and community members and compared our findings to scholarly research on water metering issues.

Our first objective was to assess the affordability of water for the residents of the informal settlements. Although our sample size of 59 surveys was relatively small compared to the total population of the informal settlements (approximately 90,000), obvious trends emerge from the data we gathered. Namely, we established in the communities we surveyed, that households in the post-pay communities spend an average of 29 percent of their incomes on water while households in prepay communities spend an average of five percent of their incomes on water. We also calculated the water expenditure per person per month to be N$22 in post-pay communities and N$11 in prepay communities. The substantial discrepancy in expenditure can be attributed to the fact that in post-pay communities, the households that pay for water must pay to compensate for the large number of households that do not pay. Prepayment is a less expensive alternative as people are only required to pay for the exact amount that they consume.

Secondly, we assessed opinions and attitudes of community members concerning water payment and costliness. Although over half of the residents surveyed did not have to pay for water before they moved to the City, 93 percent asserted that payment for water is necessary. In addition, a large majority of the residents are, in fact, aware that they are paying to support the infrastructure necessary to clean and distribute water, not necessarily the water itself.

With respect to the costliness of water, there is again a strong difference in attitudes between post-pay and prepay users. Within the post-payment communities, 73 percent of residents believe that water is in fact too expensive. These residents stated that it is very hard to come up with enough money to pay their water bill. In addition, they state that the post-pay system is inequitable because those who pay are not necessarily those with more money. These facts highlight the effects of the problem of nonpayment within the post-payment communities. Conversely, only 11

percent of those in prepayment areas believe water to be too expensive. When water expenditure is calculated as a percentage of income, it is once again evident that prepayment is much less expensive to the user as compared to post-payment.

Our next objective was to determine attitudes towards and the severity of problems associated with each metering system. As established above, post-payment presents problems when people within the community do not pay their portion of the monthly bill. During our surveys, residents complained about the unfairness of this system. When asked about possible solutions to the problem of nonpayment, they identified prepayment as a much better option. All post-pay users surveyed said they would prefer prepay metering over their current system. They expressed that they would like to be able to control their individual water expenditure by monitoring their consumption using prepayment. They also expressed interest in being able to add credit to their account whenever funds were available.

Although many settlement residents prefer prepayment over post-payment, the system has problems that must be addressed before it can be expanded. When a resident runs out of credit on the card, he or she is unable to get water from the standpipe. Of those surveyed, 54 percent of prepay users have run out of water credit and been unable to obtain water from standpipes. Those who did not run out of credit made a point to monitor their cards and plan ahead. The POS office is only open form 8am to 12pm, Monday through Friday. The majority of people who ran out of credit did so on the weekends and were unable to add credit their cards until Monday morning. Based upon this, we recommend that the POS offices expand their hours to include weekends. This would reduce the number of people who run out of credit and are unable to get water. Another solution to this problem would be to institute a "lifeline" policy whereby users could debit their accounts when they run out of credit, ensuring that their water supply is not cut off. There would have to be a limit to the amount that can be debited to prevent abuse of the system.

We discovered through our background research and interviews with professionals the concern that the capital and maintenance costs associated with prepay meters are prohibitively high. To address this problem, our next objective aims to determine the maintenance costs and failure rates of prepay standpipes. Although we calculated the maintenance cost of a prepay meter to be about three times that of an average meter in the City, it is important to differentiate between the two. While many of the City's meters serve a single residence, the prepay meters in the

settlements serve approximately 100 residences. Considering these figures, the maintenance cost per user served is comparatively low with prepay meters. We determined the mean time between failures of these meters to be approximately 9 months. It should be noted that the design of the prepay meter is relatively new, and as the design improves with demand, the meters will require less frequent service. However, when a communal standpipe does break, many users must walk significantly farther to the next working standpipe. In addition, users claim that a malfunctioning meter can erase credit on a prepay card. Therefore, it is essential that problems with meters are reported as soon as possible to the municipality and addressed in a timely manner. Accordingly, we recommend that the municipality institute a community monitor within each community to oversee the standpipes and immediately report any problems. This paid position would not only help improve the maintenance of the infrastructure, but it will also help instill a sense of community ownership of the meters.

Residents surveyed also expressed the concern that some individuals truly cannot afford to pay for water. The post-payment system allows for the socially disadvantaged to freely obtain water. However, with prepayment, users currently cannot access water if they do not have credit. Although the community subsidization scheme in the post-pay communities is not equitable, it does insure that everyone still has access to water. Before prepayment is expanded, it is imperative that a proper subsidization scheme is established so that no resident will be denied water.

A free baseline could be established to provide a basic amount of free water necessary to sustain life for those who truly cannot afford to pay. Beyond this level of consumption, the price for water could be just above the cost recovery price to subsidize free consumption without being penalizing. As well, the increase of the block would be minimal as the informal settlements only consume two percent of Windhoek's water.

Another option would be to institute a universal tariff and offer a refund to users who consume a low amount of water. This system would encourage conservation while reducing the cost of water for those whose consumption is already minimal. Affordability of water for the poor could be ensured by setting the refund level at the minimum amount required for sustenance and issuing a complete refund for consumption under this amount. A system using a universal tariff with refund has

been established in Rehoboth and could be used as a basis for developing a similar system in Windhoek.

Although prepayment has its own associated problems, we have determined from our research that it is highly preferred by residents of the informal settlements over the current post-payment system. We therefore recommend that prepayment is expanded throughout these communities following cooperative discussions and evaluations with residents. In addition, subsidization schemes must first be reevaluated to ensure that no citizen is denied access to water. We feel that these recommendations will help ensure that every community member has access to affordable water while equitably collecting revenue to maintain the infrastructure.

ABSTRACT

Collecting revenue for water from citizens in the informal settlements of Windhoek, Namibia using the standard monthly billing system has been problematic. The current system is not socially equitable in that a large majority of residents do not pay their water bill, forcing others to pay more to compensate for the short fall. A pilot study is currently being conducted by the Department of Infrastructure, Water and Technical Services of the City of Windhoek evaluating prepay water meters as a solution to this non-payment. This project investigates advantages and problems associated with the two metering schemes through professional interviews and community surveys. Information obtained from this research is used to make recommendations for improving the metering systems.

AUTHORSHIP PAGE

Paul Kastner, J. Michael McHugh, Anne St. Martin, and Jacquelyn Youssef all contributed equally on this project in the research, data analysis, and writing.

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GLOSSARY AND ABBREVIATIONS

Affordability – the ability of a user to pay for a service.

Afrikaans – a dialect of Dutch spoke by some residents in the informal settlements of Windhoek.

Aquifer – a large underground body of water.

Arrears – unpaid funds.

Baseline amount of water – a quantity of water minimally adequate to sustain life.

Baseline subsidization – a subsidization scheme that provides residents with a quantity of water free of charge, which is minimally adequate to sustain life.

Block tariff – see *Increasing block tariff.*

Boreholes – wells drilled to access groundwater.

Box and whisker plot – a diagram with a lower line indicating the first quartile, a box indicating the range between the second and third quartiles, a center line indicating the median, and an upper line indicating the fourth quartile. Points plotted outside of the outer lines indicate outliners.

Catchments Management Agencies (CMAs) – basin level governing bodies established in South Africa to address water management issues.

CMAs – see *Catchments Management Agencies.*

Communal standpipe – see *Post-pay standpipe*.

Community Development – a municipal organization that acts as a liaison between residents of the informal settlements and other municipal organizations.

Community group – an organization of several hundred households in the informal settlements represented by a committee of leaders.

Cost recovery – obtaining funds to pay for the provision of a service.

Demographics – characteristics of a population including gender, location, employment, and income.

Department of Infrastructure, Water and Technical Services of the City of Windhoek – a municipal organization comprised of six divisions responsible for providing many services to residents including water.

Department of Water Affairs (DWA) – part of the Ministry of Agriculture, Water and Rural Development, and made up of two directorates: the Directorate of Resource Management and the Directorate of Rural Water Supply.

Department of Water Affairs (DWA) – part of the Ministry of Agriculture, Water and Rural Development and responsible for directing national water policies and initiatives.

Desert Research Foundation of Namibia (DRFN) – an NGO which conducts research concerning Namibia's environment and inhabitants.

Directorate of Resource Management – a subdivision of the DWA responsible for management, planning, control, and guardianship of the water sector.

Directorate of Rural Water Supply – a subdivision of the DWA responsible for providing clean, safe water to Namibians.

DRFN – see *Desert Research Foundation of Namibia.*

DWA – see *Department of Water Affairs.*

Ephemeral rivers – rivers that do not flow year round, only when supplied by rainfall.

Erf (*pl.* erven) – plot of land. *(Afrikaans)*

Groundwater – water located beneath the surface of the Earth, sometimes in aquifers.

Human right – a provision deemed necessary for an acceptable standard of human living.

IBT – see *Increasing Block Tariff.*

Increasing block tariff (IBT) – the pricing scheme used for water by the city of Windhoek in which users with low levels of consumption are subsidized and users with high levels of consumption are penalized.

Informal settlements – an area with few or no permanent structures and minimal infrastructure such as sewage pipes, paved roads, electricity, and telephone service.

Integrated Water Resource Management (IWRM) – a holistic approach to managing water, which considers all stakeholders, and focuses on the present and future needs of a society, thereby aiming at maximum sustainability.

Interdisciplinary Qualifying Project (IQP) – a project completed by Worcester Polytechnic Institute students uniting science and technology with an aspect of social science.

IQP – see *Interdisciplinary Qualifying Project.*

IWRM – see *Integrated Water Resource Management.*

Lifeline policy – a policy which allows water usage to be debited on a prepay card.

Maintenance cost – see *Service cost.*

MDGs – see *Millennium Development Goals.*

Millennium Development Goals (MDGs) – an initiative by the UN's WHO to improve living conditions in developing nations by the year 2015.

NamWater – a parastatal responsible for distributing water throughout Namibia.

NGO – see *Non-Governmental Organization*

Non-Governmental Organization (NGO) – a non-profit organization, often advocating humanitarian development and environmental preservation.

Otjiherero – an indigenous language spoke by some residents in the informal settlements of Windhoek.

Otjiwambo – an indigenous language spoke by some residents in the informal settlements of Windhoek.

Parastatal – a company that is fully or partially owned by the government.

Perennial rivers – rivers that flow year round.

Point of Sale (POS) – a location at which residents can purchase prepay water credits as well as pay monthly bills for land, post-pay water, and refuse removal.

Polytechnic – see *Polytechnic of Namibia*.

POS – see *Point of Sale.*

Post-pay metering – a method of charging for water consumption in which the user pays for water after obtaining it.

Post-pay standpipe – a standpipe with a meter attached and a spigot which dispenses water when opened. Users receive a communal bill for consumption at the end of the month.

Potable water – water fit for human consumption.

Prepay metering – a method of charging for water consumption in which the user pays for water before obtaining it.

Prepay standpipe – a standpipe which dispenses water when a prepay card is inserted. Credit is deducted from the token card as water is used. When no credit remains, the meter will not dispense water.

Reservoir – a body of water, often artificially created by a dam and used to collect and store water.

Sanitation – cleanliness, often used in reference to human waste.

Service cost – expenditure for labor, parts, and other costs necessary to perform maintenance.

Service records – records detailing instances in which maintenance was performed.

Shack – a small dwelling composed of a wooden frame and corrugated steel roofing and siding.

Stakeholder – a person or organization who is effected by a particular issue or situation.

Standpipe – a pipe with a spigot that dispenses water.

Subsidization – an arrangement in which some residents pay for the services of other usually less wealthy residents.

Tariff – a fee charged for a service.

The Department of Bulk Water and Wastewater – a division of the Department of Infrastructure, Water and Technical Services of the City of Windhoek responsible for producing and distributing potable water as well as semi-purified water for irrigation. The Department also collects and treats wastewater.

The Polytechnic of Namibia – an institution of higher learning in Windhoek, Namibia.

Token card – a small card that stores water credits. When inserted into a prepay standpipe, water is dispensed and the balance of credits on the card declines.

Trial survey – an initial survey conducted to asses the effectiveness of a questionnaire prior to the full study.

Tribunal – a group of people entrusted to make impartial judgments.

UN – see *United Nations.*

United Nations (UN) – A multinational organization with many programs dedicated to ensuring acceptable living standards.

Universal tariff with rebate (UTR) – a pricing scheme used for water which charges a fixed amount for all levels of consumption and offers a rebate to users who consume under a certain limit.

UTR – see *Universal tariff with rebate.*

Water Act 54 of 1956 – the policy governing water affairs in Namibia prior to the current policy (the Water Resources Management Act of 2004).

Water infrastructure – the piping, structures, and equipment used to clean and supply water.

Water reclamation plant – a plant at which wastewater is processed to produce potable water.

Water Resources Management Act of 2004 – the policy currently governing water affairs in Namibia.

Watermaster – a manufacturer of prepay water meters.

WHO – see *World Health Organization.*

World Health Organization (WHO) – a division of the UN which recommends guidelines for human health standards.

CHAPTER 1: INTRODUCTION

Access to clean potable water has become increasingly problematic in developing nations with limited water resources. After the United Nations declared water a basic human right in 2002, most governments adapted their water legislation to ensure that every citizen has access to enough water to sustain life (Simonson, 2003). As the driest country in Sub-Saharan Africa, Namibia has very limited water resources and a high associated management cost. Although many people agree that water itself should be free, revenue must be collected to support the infrastructure necessary to collect, clean, and distribute water. In order to collect revenue from end users, individual water usage would have to be metered, but this is difficult in the informal settlements of Windhoek where many people share the same water tap. Our project identifies and recommends ways to address the problems associated with metering and payment.

The informal settlements of the city of Windhoek are primarily inhabited by Namibians who moved to the City from rural areas after Namibia gained its independence in 1990. Most inhabitants of these settlements are unemployed and a substantial amount live below the UN poverty line of one US dollar per day (http://factbook.wn.com/Namibia). Several hundred shacks, each housing around five people, form different community groups within the settlements. Each community group has a leader or a council of leaders who act as representatives for the community members.

In most of these settlements, water is distributed through communal standpipes that supply as many as 100 shacks. The leaders of these settlements are given a monthly bill for the amount of water consumed and are responsible for collecting money from community members. In theory, each household is responsible for an equal portion of the bill. However, in some cases, up to 40% of households do not pay their share leaving the remaining 60% to subsidize the usage of their neighbors as well as pay for themselves (conversation with G. Samueis, 2005). Moreover, those who do pay their share of the bill are not necessarily those who can best afford it. Our project includes an investigation of this inequity.

In 1998, the Department of Infrastructure, Water, and Technical Services of the City of Windhoek introduced a pilot program of prepay metering in a few of the informal settlements (conversation with F. Brinkman, 2005). With prepay metering, each household purchases a prepay card used to store purchased water credits. To obtain water, the user inserts the card into a prepay standpipe and as water is dispensed, the balance on the token declines. This system ensures that each household is responsible only for the water it consumes and ensures payment by all users, alleviating the need for subsidization within a community. However, prepay metering does have several drawbacks. Most notably, those without credit on their card can be denied their basic water needs and are forced to turn to other sources. This violates guidelines set forth by several Non-Governmental Organizations (NGOs), including the World Heath Organization (WHO) and the Labor Resource and Research Institute (LaRRI), stating that access to water is a human right (WHO, 2003) (McClune, 2004).

The current post-pay system in the majority of informal settlements is essentially subsidization of the poor by the poor. However, the alternative system, as illustrated above, also has its associated problems. This project investigates issues surrounding payment in prepay and post-pay communities of Windhoek and recommends improvements. We conducted community surveys to investigate the affordability of water for residents of the informal settlements, the residents' attitudes about paying for water and the metering systems, and also the severity of problems associated with metering systems. Moreover, we performed a cost analysis to determine the fees associated with the installation and maintenance of prepay meters.

A total of 59 surveys were collected from residents of the informal settlements and ten from the Okuryangava point of sale location. Although only a small number of surveys were collected, trends in the information were very apparent. Our research indicates that prepayment is not only an efficient, affordable, and equitable way of addressing the problems associated with the post-pay system, but it is also more accepted by the communities.

It is our recommendation that prepayment be expanded to more communities. However, with the expansion of prepayment it is also essential that Windhoek's subsidy scheme is reevaluated in connection with prepayment to guarantee that water is not denied to any resident. The implementation of prepayment and a new subsidy scheme would relieve the burden of payment on the socially disadvantaged while ensuring that all residents have access to a sufficient amount of water.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

The issue of adequate water access has been explicitly acknowledged in the UN's Millennium Development Goals (MDGs), an initiative to improve living conditions in developing nations by the year 2015. Target ten of the MDGs aims to "Halve by 2015 the proportion of people without sustainable access to safe drinking water." Sustainable access includes the requirement that water be affordable for all to ensure that no one is denied the basic human right to water (WHO, 2003).

Namibia must carefully manage its scarce water resources to ensure that all citizens are provided adequate, affordable access while simultaneously collecting revenue to maintain and develop distribution infrastructure. In the informal settlements of Windhoek, where roughly 40 percent of the City's population resides, the provision of water and the associated collection of payment are complicated by the scarcity of water in Namibia and the extreme poverty of some of its citizens. In order to address water payment concerns in these settlements, it is essential to develop an understanding of water management issues and work with various stakeholders to gain a broader perspective. This must be done to ensure that a balance is reached between collecting revenue to support infrastructure and providing all citizens with affordable access to necessary services.

WATER SUPPLY AND COVERAGE

In order to understand the state of water management in Namibia, it is necessary to examine Namibia's current water supply and coverage. Presented below is a comprehensive overview of the water system through an evaluation of the available natural water resources, distribution infrastructure, and consumer demographics.

Climate

Namibia is the driest Sub-Saharan African country and is extremely vulnerable to water shortages. Due to ocean currents, global air circulation, and topography, Namibia only receives an average of 430 millimeters of rain each year (Water Supply & Sanitation Sector Assessment Part II, 2000). As a result of its semi-arid climate,

approximately 83 percent of rainfall evaporates and 14 percent is used by the environment. This leaves only two percent available as runoff and one percent to recharge the groundwater (Environmental Assessment Guidelines – Water infrastructure, 2001). Moreover, Namibia's rainfall varies greatly from year to year, increasing the need for proper long-term water management. For example, the City of Windhoek may receive close to 600 mm of rainfall one year, but only 200 mm the next.

Water Sources

There are several sources of water in Windhoek including perennial rivers, ephemeral rivers, boreholes, reservoirs, and a reclamation plant. Figure 1 shows the contribution of each these sources in 2002. Extracting water from each source presents its own set of benefits and challenges. Water is provided to the City through an extensive pipeline network covering 2000 kilometers (Van der Merwe, 2000).

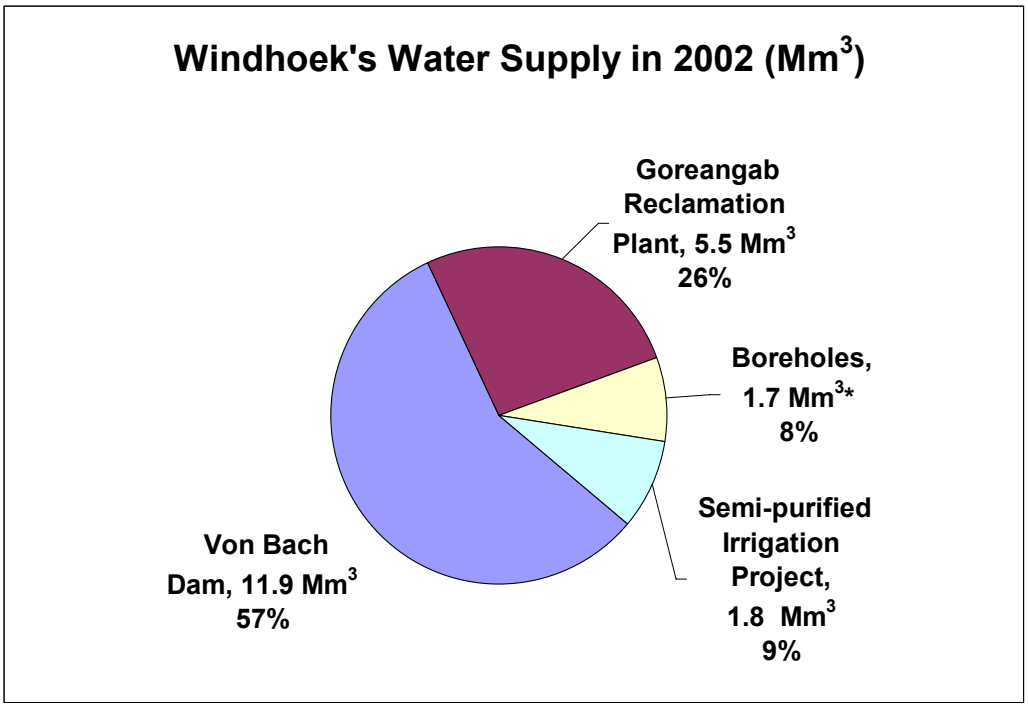


Figure 1: Windhoek's Water Supply in 2002

Perennial rivers that flow year round could potentially provide 69,000 million cubic meters of water per year to Namibia (Van der Merwe, 2000). However, Namibia's perennial rivers are located on its border and must be shared with neighboring countries. International negotiations hampered by economic and environmental concerns have yielded few agreements to allow Namibia access to this water. While no perennial rivers flow through Windhoek, water from these rivers

contributes to the supply provided to the City by the Namibia's bulk water supplier, NamWater (see APPENDIX C: LEGISLATIVE INTSTITUTIONS AND NAMIBIAN WATER LEGISLATION for further information on Namibian water legislation).

Ephemeral rivers flow only when filled by rainfall and consequently are not a reliable source of water. Nonetheless, they are an important supplement to perennial water sources. Ephemeral rivers provide about 73 percent of the water supply to Windhoek (Van der Merwe, 2000). Reservoirs created by dams such as the Von Bach, the Swakoppoort, and the Omatako on ephemeral rivers provide about 17 million cubic meters of water per year (Van der Merwe, 2000). However, damming can cause conflicts by limiting flow to downstream users. It is therefore essential that this infrastructure be properly managed through the co-operation of all stakeholders.

Boreholes provide access to underground water. Ten percent of Windhoek's water is extracted from 50 municipal boreholes yielding about 2.3 million cubic meters per year.

Water is also supplied by water reclamation from domestic sewage. The Goreangab Water Reclamation Plant in Windhoek has the capacity to turn raw domestic sewage into 21,000 cubic meters of potable water per day. This process accounts for approximately 30 percent of Windhoek's total water demand and uses a low amount of energy (NORIT, 2003). The water distributed through the reclamation plant is tested weekly by the municipality (conversation with Geiseb, 2005) to ensure that the water is of high quality.

Figure 2: Water Reclamation Plant

WATER USERS

There are several different types of water users in Namibia. Noting the distinction between these different consumers is important because not only do they use different amounts of water, but they also fall into substantially different income brackets. Therefore, it is important to understand the different classes of users in order to adequately analyze problems associated with water management in each area. Two broad classes are residential and commercial users (See APPENDIX D: COMMERCIAL WATER USERS). In considering pricing schemes, it is noteworthy that commercial users consume substantially more water than residential users. Figure 3 shows the distribution of water consumption by sector.

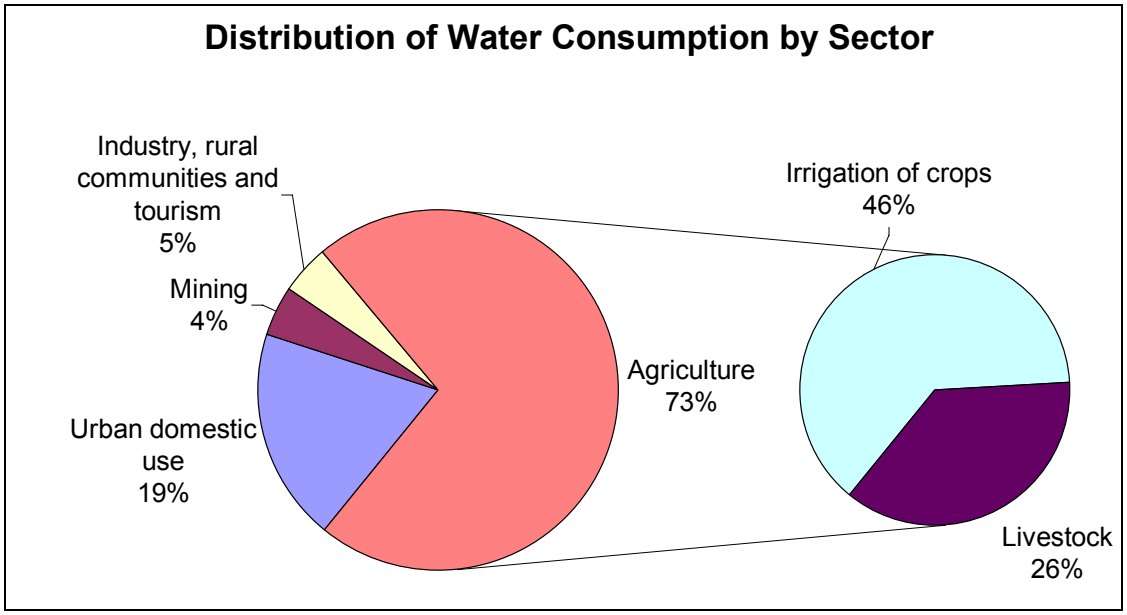


Figure 3: Distribution of Water Consumption by Sector

Residential Users

As of 2001, 98 percent of the urban population and 80 percent of the rural population had access to potable water. Access to potable water by the rural population has almost doubled since 1991, while access by the urban population has remained fairly constant (Namibia Millennium Development Goals Report, 2004).

Windhoek is experiencing a population growth rate of about 5 percent per year, mainly due to the influx from rural areas. The newcomers to the City, who often move to informal settlements, cannot always afford water services and often demand that water be provided at no cost or at a highly subsidized rate; however, the City

must collect revenue to the water treatment and delivery system that provides adequate water to residents.

INFORMAL SETTLEMENTS

On the north and northwestern outskirts of Windhoek, the poorest citizens of the City live in what are known as informal settlements. These areas are characterized by one-room, tin or corrugated iron shacks that house about five people on average. A picture of a section of the informal settlements is shown in Figure 4. The majority of informal settlements in the city of Windhoek are inhabited by Namibians who moved to the City from rural areas after Independence. Legislation before Independence prohibited the construction of any such living quarters. However, after Independence, there was a substantial influx of rural migrants, to the City, seeking employment. Since most of these settlers had no family in Windhoek, the government donated land so people could remain together in communities. Mr. George Samueis, one of the City's Community Development officers, spoke with us about community structure and water metering in the informal settlements.

Community Structure

Each community in the informal settlements is made up mostly of members of a single ethnic group, which provides a strong sense of camaraderie among community members. A community is governed by a committee of leaders who are responsible for the welfare and conduct of the community. Although the settlers moved to the City to find work, only about 40 percent of house owners actually work in the City (personal communication with Mr. G. Samueis, 16 March 2005). In contrast, there are also some settlers who have government jobs and drive cars but prefer to remain in the settlements with their extended family and tribes.

The informal settlements are divided into three different categories based upon the total income of each household. The categories are partitioned into level 1, level 2, and level 3 consisting of households with monthly incomes under $N500, from $N500 to $N1800, and over $N1800, respectively.

Figure 4: Informal Settlements of Windhoek

Sanitation

The level of sanitation in the informal settlements is very low. Efforts towards improving sanitation are often blocked by a lack of understanding of proper sanitation methods by the community members. Most of the communities have makeshift tin enclosures, as pictured below in Figure 5, in which the members bathe and relieve themselves. Some communities also have permanent concrete structures with running water and sewer connections that are maintained by the City. Many of these facilities break because of vandalism or misuse, which leaves the community members to use the unsafe and unsanitary toilet and washing structures mentioned before.

Figure 5: Washing and Toilet Facility

WATER METERING WITHIN THE COMMUNITIES

Most rural Namibians are supplied with water from boreholes dug by the government, and do not have to pay for the water they consume; many migrants from the countryside bring this attitude about water being free to the urban settlements. However, in Windhoek there is a cost associated with providing and distributing water to all the settlements. The municipality of Windhoek utilizes two different types of billing and metering systems in the informal settlements: post-payment and prepayment. Prepay metering was begun in 1998 as a pilot program to assess the effectiveness of the system.

Post-pay Metering

The watering points in many communities are individually metered standpipes consisting of a mechanical meter and a spigot, as shown in Figure 6. Municipality workers visit each meter monthly to record meter readings.

Multiple families in each community share these water points. As a result, some individuals do not feel the financial responsibility for the water they use and often water is not conserved. Moreover, water can be wasted when standpipes are left running, an indication of which is the damp soil surrounding the standpipe as shown in Figure 6.

Figure 6:Post-pay Standpipe and Meter

Problems Associated with Post-Pay Metering

Since the majority of communities obtain their water from a shared standpipe, the community is given a monthly water bill, which is divided equally among all the households, and it is the responsibility of the community leaders to collect money from its members. This creates problems as settlers who have never had to pay for water are now being asked to pay for a portion of the water that their entire community consumes. Although most of community members pay their monthly bill of approximately N$80, there are some who do not pay. In turn, the next month's bill is increased and those who do pay are forced to pay extra to cover the costs of nonpaying community members. To recover arrears accumulated from nonpayment, the amount of money requested at the end of the month from each household is greater than an equal portion of the actual bill from the municipality.

If there is a concentration of non-paying inhabitants around a standpipe, a community may opt to have it shut off as a punitive action. The users of the standpipe can still obtain water, but must walk farther to another standpipe. This is neither an effective nor equitable penalty as it inconveniences people who pay their bills in addition to those who do not. According to Mr. G. Samueis (Personal communication, 16 March 2005), problems arise when people learn that there is no consequence for unpaid water bills, especially if the community will compensate for them. This nonpayment is very unfair to the entire community as people within the same income

bracket must then pay for their neighbor's unpaid water consumption. However, it is very difficult to force a household with an extremely low income to contribute funds to the community bill. Mr. G. Samueis has been approached numerous times by community leaders who are unable to collect money and require outside assistance to force payment. In the past, the Community Development Office has successfully collected unpaid bills by threatening to evict people from the land. However, recently communities have begun to form savings groups to slowly purchase the land they live on, and the legality of such threats of eviction are no longer valid. Therefore, the responsibility falls solely on community leaders to insure that members pay their bills, which is a very difficult task. Since this scenario is unfair to individuals and the community as a whole, many community leaders have begun to show interest in the option of prepay meters. With prepay meters, residents will only have to pay for the water they consume, and no one will be forced to cover the bills of the other community members.

Prepay Metering

The municipality's pilot study of prepay meters began in 1998 and has had mixed success (Personal communication with Mr. F. Brinkman, 13 March 2005). In order to use a prepay meter, a community member must purchase a card that stores water credits. The card can then be inserted into a prepay meter to dispense water. Credits decline as water is used until the card becomes empty and water can no longer be obtained.

Prepay meters ensure that people are only responsible for the water they consume. They also force water to be paid for before it is used, eliminating the possibility of nonpayment.

Problems with Prepay Metering.

Prepay cards must be recharged at a point of sale offices, which is open weekdays from 8:00 am to12:00 pm. These limited hours of operation may present a problem for some users as the office is distant from some settlements and the hours of operation may conflict with work schedules. One of the two offices, which is located in Okuryangava, is shown in Figure 7. The other office is located in the Wanaheda area of the informal settlements.

Figure 7:Okuryangava Point of Sale Office

While the problem of nonpayment for water has been eliminated in the communities in which these meters have been installed, they require a large capital investment and a high level of maintenance compared to post-pay standpipes. Breakage occurs as a result of vandalism as well as internal mechanical wear. A common form of vandalism is the insertion of objects into the card slot to prevent the use of the meter. An example of a prepay meter is depicted Figure 8. The black object protruding out of the front of the meter is the individual's prepay card, which stores her water credits. Figure 9 shows the components inside of a prepay meter.

Figure 8: Prepay Meter

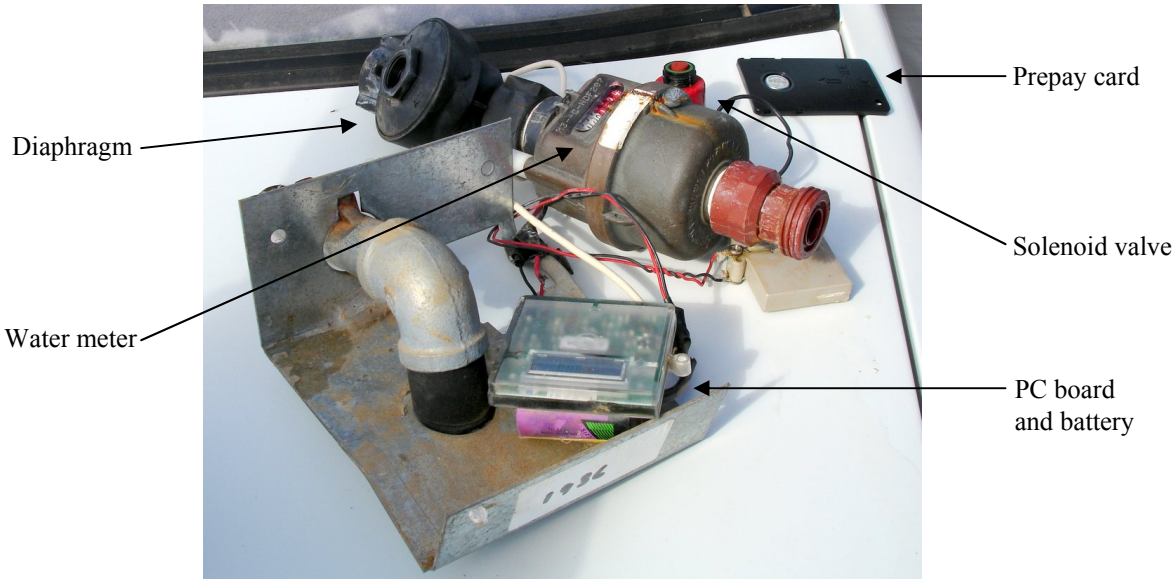


Figure 9: Inside of Prepay Meter

The major concern with prepay metering is that meter will not distribute water unless there is credit on the card. If consumers forget to add credit to their card or if their income is extremely low and they are unable to purchase credit, then they will not have access to water. However, the prepay system has the ability to be programmed to provide a lifeline amount of free water for people who run out of

credit or a baseline amount of water for people who cannot afford to purchase credit. In order to provide the basic amount of water at no cost, to the poorest residents, adequate subsidization must be employed.

Water Pricing in Namibia

In 1920, the government of what was then South West Africa did not charge consumers for water. However, the government soon realized that the costs of delivering free water in such a sparsely populated and arid nation were too great and they began charging. In 1954, the DWA introduced a bulk water tariff of US$0.06 per cubic meter that applied to all users (Heyns, 1997). This pricing scheme was not economically efficient and was therefore unsuited for the specific needs of the country; it did not take into account the economic range of users. More recently, water pricing has been modified to reflect the different economic levels of users, proving to be a more equitable and efficient resource management method.

Namibian Water Corporation Ltd.

The water distributor, NamWater, is not paid directly by end users. Rather, municipalities are responsible for selling the bulk water they purchase from NamWater to the end users. There is currently a large debt of N$80 million owed to NamWater by municipalities across the nation. As a result, NamWater has decided to reduce or cut off the water supply to some regions (Dentlinger, 2004). The fact that these local governments cannot pay indicates that the end users cannot afford water or do not feel obliged to pay what they are being charged. It is necessary to consider these social issues as well as the opinions of the affected users when analyzing the current payment and metering schemes in the city of Windhoek.

Water Pricing in Windhoek.

The city of Windhoek established a block tariff system for water in 1995. Under this system, the rate for water increases with consumption. This system was designed to encourage conservation and provide for subsidization of the poorest citizens by the larger body of paying consumers. As of 2004, the block tariff pricing for water in Windhoek is as shown in Table 1 (City of Windhoek, 2004).

Table 1: Current Water Pricing Scheme in Windhoek (City of Windhoek, 2004)

Amount of Water	Price per Kilolitre
Less than 6 kl.	N$4.17
Between 6 kl. and 45 kl.	N$6.94
More than 45 kl.	N$12.78

In Windhoek's informal settlements, a flat rate system is being used for the financing of water. Every household pays a set price for water at the beginning of each month to cover unlimited use for that month. The next month's flat rate will rise or fall to cover the costs of the preceding month's consumption. Under this system, water costs are divided equally among the community's households (personal communication with Mr. F. Carew, 15 March 2005).

Evaluation of the Increasing Block Tariff System

Windhoek, like many other cities in developing nations, uses an increasing block tariff (IBT) to price its water. Although this system is viewed by some as a good way to provide subsidy to the poor and promote conservation, others argue that it is too complicated, inefficient, and confusing.

The IBT is designed in such a way that the lowest block, which supplies the essential amount of water required for survival, is priced below the cost of providing that water. The highest block is priced above the marginal cost of water so that the citizens who use the most water must pay the higher price. It is constructed in this manner to provide subsidization to those who are only using the essential amount of water in the lowest tariff block.

Opposers of the IBT argue that the poor do not always receive adequate subsidization because there is no set standard for the lowest block. Because each family varies in size, and because the amount of water subsidized by the smallest block is held constant, some larger families do not receive subsidization for the essential amount of water. Because of these variations in household sizes, it is very complicated to set the initial tariff block. In addition, in order to truly subsidize the poor, the block would have to be very small amount of water (Dinar, 2000).

Water utility experts state that full cost recovery and conservation can be achieved by using an increasing block tariff to match marginal cost, ensuring that every unit of water that is consumed is replaced (Hall and Hanemann, 1996). This

principle holds that as more water is purified and distributed, the cost to pay for this distribution also increases. Moreover, it is asserted that water conservation is promoted with the increasing block tariff because the price of the highest block is made punitively high (Dinar, 2000). However, the price increase in the IBT does not match marginal cost because it fails to take into account the effect of multiple water users. The increase in the tariff does not consider that the price increase of water distribution for a single user is not representative of the price increase for multiple users (Boland, 1992). The IBT system assumes that there is a linear relationship between water consumption and the cost to provide water. Yet, this is not so, as multiple users create a nonlinear relationship between water consumption and the cost to provide water (Dinar, 2000).

Developing a Water Pricing Policy: Case Studies

When analyzing current pricing and subsidization schemes, it is beneficial to reflect on similar situations in other countries to aid in developing viable recommendations. The following examples illustrate policy initiatives in Chile, Australia, Brazil, Yemen, Zimbabwe, and South Africa concerning water subsidization.

Water Subsidization: Chile, Brazil.

Many governments have taken different approaches to subsidizing water for the poor. Chile funds its subsidies through tax payments. To determine eligibility for the subsidy, a scoring system is utilized that takes into account different economic factors such as the size of a household, living conditions, occupation and income, and ownership of durable goods. This system was considered a success in that it relieved much of the burden that was placed on the government under the universal subsidy system (Dinar, 2000).

Rio Grande do Sul, Brazil studied the effects of three different subsidy scenarios which involved 0, 40, and 100 percent subsidization of rural costs by industry. In all of these scenarios, the operational cost for industries only varied by a maximum of 1.45 percent, suggesting that full cross-subsidies do not create a burden on industry (Dinar, 2000). A similar approach could be used for subsidization in Namibia, where ten percent of its water is consumed by non-agricultural industry (MAWRD, 2000).

Water Commoditization: Brazil.

Another conceptual issue with water pricing is whether water should be treated as an economic good. In Brazil, legislation was passed that defined water as "a public good with economic value," making the price of water subject to a market price that is based upon its aggregate demand (Dinar, 2000). This legislation, however, also takes into account times of drought, and asserts that water is to be first allocated to residential users, and then given out to the highest bidders (Dinar, 2000).

Environmental Degradation: Yemen.

Environmental issues must also be taken into account when pricing water. Ideally, water should be priced in such a way that it is affordable to all users, while the price still promotes conservation. In Yemen, groundwater was supplied to citizens at a price below its economic worth. However, in 1995, new regulation was made to increase the price of groundwater resulting from the concern that this source would be depleted.

INTEGRATED WATER RESOURCE MANAGEMENT

The international community has recognized and heavily promoted the practice of Integrated Water Resource Management (IWRM) in water management. IWRM focuses holistically on the present and future needs of a society, thereby aiming at maximum sustainability (Jaspers, 2003). It strives to empower communities on the most basic level to take responsibility for their own water management. In February 2003, the Desert Research Foundation of Namibia adopted the IWRM approach from the Global Water Partnership after witnessing its success in Zambia and Zimbabwe (http://www.gwpsatac.org.zw/swf/partners/namibia/index.htm).

The IWRM approach was derived from the Dublin principles, which were formulated by a cooperative international process and announced at the International Conference on Water and the Environment in Dublin in 1992. These principles have established the foundation for modern international water policy as they were adopted in the Agenda 21 recommendations at the United Nations Conference on the Environment and Development in Rio de Janeiro in 1992. These principles include:

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment

- Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels
- Women play a central part in the provision, management and safeguarding of water
- Water has an economic value in all its competing uses and should be recognized as an economic good

Moreover, IWRM places a strong emphasis on stakeholder participation, asserting that community action is indispensable in ensuring the sustainability of water management. A large component of success depends on the level of decision making within disadvantaged communities, as well as the degree to which these communities are empowered to address poverty issues and equitable distribution of natural resources (Anderson, 2005).

This approach has been implemented in South Africa where 19 basin level governing bodies known as Catchments Management Agencies (CMAs) were established to address substantial water management issues (Schreiner, 2002). South Africa has discovered that in order to ensure the success of this initiative, it is necessary to recruit from a variety of communities and secure representation of all water users. Creative approaches must be used to achieve this goal. In South Africa, it was demonstrated that the best way to reach disadvantaged communities was through church and school announcements (Anderson, 2005). In addition, meetings must be held in the language and at the technical level of the people; otherwise participation will be discouraged (LeBaron, 2002).

To guarantee the success of IWRM, it has been suggested that initial discussions place an emphasis on defining problems as well as finding solutions. An emphasis on problem definition ensures that the stakeholders fully understand all issues associated with the problem while providing ample opportunity to make contributions to the process. This holistic approach supports the sustainability of the solution as a collective decision is made by representatives from all communities, and all communities can feel confident that they have played a role in the decision-making process.

Implementing IWRM: Case Studies

It is helpful to consider the possible problems that may arise when utilizing an IWRM approach. The results of implementing the IWRM approach can be observed through case studies in Pakistan, Brazil and Australia.

Regulatory Framework in IWRM: Pakistan, Brazil.

In Pakistan, the management of water was transferred to farmers. Commissions of farmers were established without a governing body to oversee them, and without a regulatory framework to guide their initiatives. The lack of oversight and regulatory framework made the approach unsuccessful; the majority of farmers were too concerned with their own interests to work cooperatively on communal issues (Wambia, 2000). In comparison, when Brazil implemented the IWRM approach, it immediately established a regulatory framework that could be used to oversee community committees. This framework had legislation that defined water as an economic good and provided agencies with flexibility to change policy in conjunction with needs and situations.

The Use of Tribunals in IWRM: Australia.

Australia approached the same regulatory problem by introducing a Water Tribunal to hear and decide on matters related to water resources. The Tribunal consists of people without vested interest. Although the members of the Tribunal worked with the municipality and communities, they were responsible for making the final decisions. The Tribunal is also responsible for keeping the community informed by discussing possible policy changes and the community's opinions of these changes.

As the driest country in Sub Saharan Africa, Namibia faces great challenges with respect to water resource management. In order to ensure water distribution to all citizens, NamWater must operate on a cost recovery basis to fund its own operations. Therefore, there must necessarily be an associated cost to water distribution. However, some citizens of Namibia, as within Windhoek's informal settlements, live below the poverty line and are not always able to pay for the services. In addition, problems arise with informal communities that use the post-pay system and share the

monthly water bill. A lack of payment enforcement results in nonpayment by a large portion of the community, forcing the remainder of the community to pay more. Essentially this results in a system in which the poorest are subsidizing the poorest. Prepay metering can be utilized as a method to instill individual payment responsibility to community members. However, the greater issue of subsidization for those who cannot afford to pay for the basic amount of water must first be addressed. Case studies provide examples of successful and problematic methods of addressing water issues.

CHAPTER 3: METHODOLOGY

The goal of this project is to assess metering systems in the informal settlements of Windhoek and recommend improvements. In order to achieve this goal we established the following objectives:

1. Assess the affordability of water in the informal settlements.
2. Assess community opinions and attitudes concerning water payment and metering systems.
3. Identify and determine severity of problems associated with metering systems.
4. Evaluate the use and convenience of current prepay points of sale locations.
5. Determine maintenance costs and failure rates of prepay communal standpipes and meters.

To complete these objectives, we followed a specific methodology, consisting of three components: interviews with professionals, interaction with communities, and cost analysis. The first portion of our methodology consisted of interviewing employees of the Department of Water, Infrastructure and Technical Services, Community Development, and other experts in the water sector. Our involvement with the community consisted of surveying and interviewing community members and leaders regarding their opinions and attitudes concerning water payment and metering schemes. Also, we performed a cost analysis to assess the long-term expense of using a prepay system to the Department and the communities. Finally, an analysis of our results was used to make recommendations to the Department for improving the metering, distribution and payment systems.

Professional Interviews

To expand our understanding of water management in Namibia, we conducted interviews with local professionals in the water sector. We spoke with employees of the City of Windhoek including Ferdi Brinkman, and Frank Carew at the Department of Infrastructure, Water and Technical Services. In addition, we interviewed the head of the Department, Piet du Pisani. We also interviewed the former head of Windhoek's Water Department who currently works as a private water consultant,

Benjamin Van der Merwe, as well as Anna Matros, head of the Water Desk at the Desert Research Foundation of Namibia (DRFN). Summaries of these three interviews are available in

APPENDIX E: INTERVIEWS. We also held conversations with George Samueis of Community Development in order to help identify water issues in the communities of interest.

We worked closely with two professionals at the Department of Infrastructure, Water, and Technical Services of the City of Windhoek: Ferdi Brinkman, Chief Engineer of Bulk and Waste Water, and Frank Carew, Senior Water Meter Mechanic. We held many informative conversations with both of these individuals throughout our time at the Department. In our first conversations with Mr. Brinkman, he identified current metering and payment problems in the informal settlements as well as suitable communities in which to conduct our research. Mr. Carew took us on tours of the informal settlements. He is the Chief Water Meter Mechanic responsible for overseeing the maintenance of the prepay meters in the informal settlements and works daily in the communities. During the tour, Mr. Carew outlined current problems in the communities such as broken facilities, lack of sanitation, and lack of payment for water. Mr. Carew also provided us with numerous documents such as a log of meter breakage and repair and the cost of replacing certain meter parts.

Mr. Ben Van der Merwe worked for the City until 1996 as head of what was then known as the Water Department and is now a private water consultant at Africon. Mr. Van der Merwe described the increasing block tariff pricing scheme he designed for Windhoek and its implications. He also discussed the positive results achieved by a system he designed for Rehoboth, a nearby city, involving a flat rate tariff with a universal refund. We also discussed the feasibility of several hypothetical subsidization scenarios for the informal settlements in Windhoek.

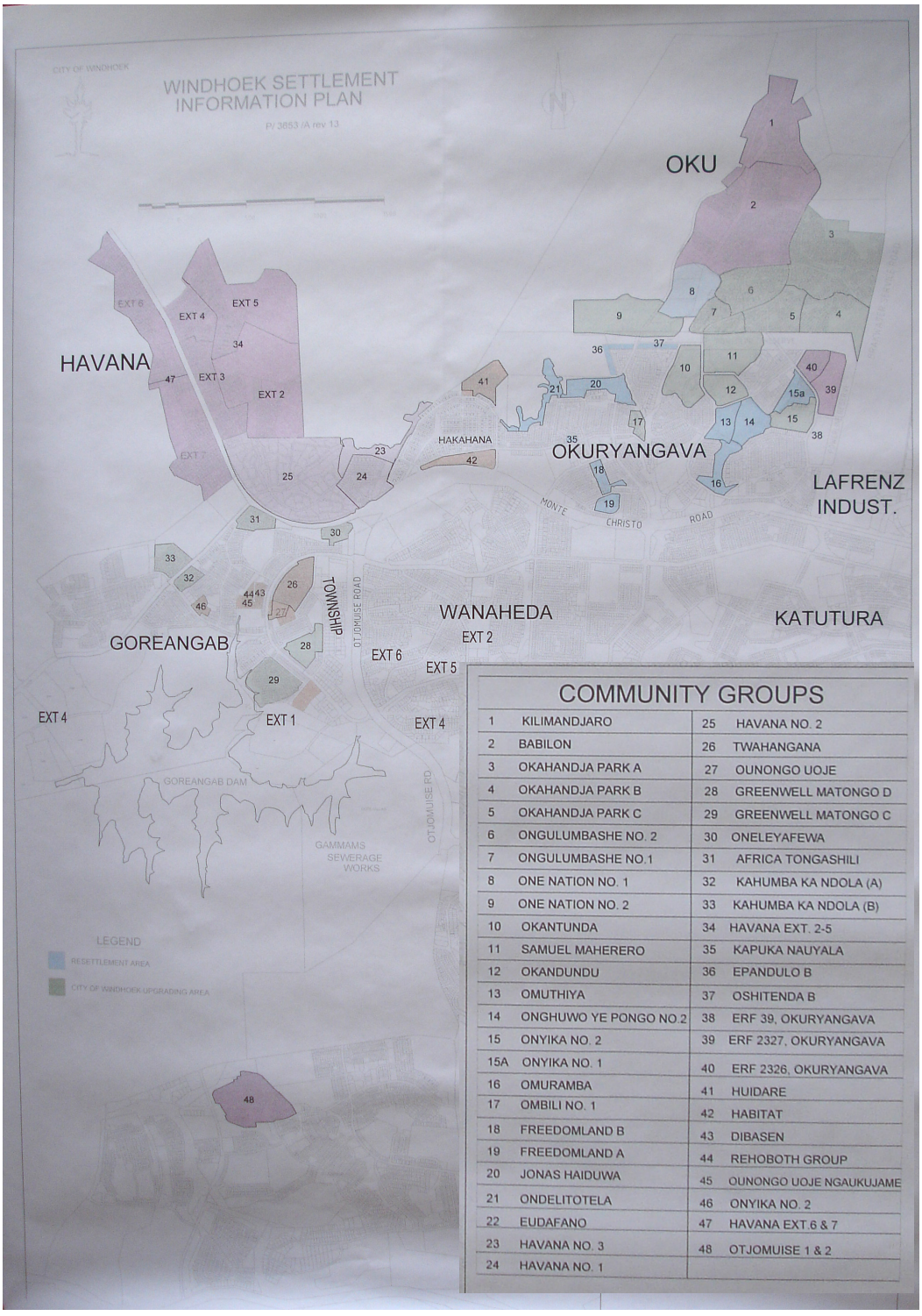
We worked closely with Mr. G. Samueis from Community Development. Mr. Samueis works daily with communities in the informal settlements. He serves as a liaison between community members and various departments in the municipality to identify problems and facilitate interaction. In our conservations with Mr. Samueis, he informed us about problems with water bill payment and described the lack of enforcement for payment collection.

To learn more about the history of water policy and NGO involvement in Namibia, we interviewed Anna Matros, an employee of the Desert Research Foundation of Namibia (DRFN). Ms. Matros specializes in Integrated Water Resource Management and community interaction. We discussed the role of Water Point

Committees (WPCs) in rural areas, water pricing, and the evolution of current Namibian water policy.

Community Surveys

In order to accomplish our project objectives, it was important that we interacted with the community members of the informal settlements. To identify problems and assess opinions in the communities, we performed surveys of both individuals within and leaders of the communities. With the assistance of F. Brinkman, we identified four specific community groups to survey: Africa Tongashili, Havana numbers 1 and 2, Okuryangava erven (see Glossary) 2326 and 2327, and Havana extensions 2 through 5. Two of these communities, Africa Tongashili and Havana numbers 1 and 2 (Groups 31, 24 and 25 respectively in Figure 10), use the post-pay system. Costs incurred by the use of the communal standpipes are divided among the community members. The leaders of Africa Tongashili have recently requested the installation of prepay meters to help alleviate nonpayment problems they have been experiencing. As of the writing of this report, the installation of the prepay meters is still pending. The other two community groups, Okuryangava erven 2326 and 2327 (which will henceforward be referred to as Okuryangava) and Havana extensions 2-5 (Groups 39, 40, and 34 in Figure 10), currently use prepay meters manufactured by Watermaster.



COMMUNITY GROUPS

1	KILIMANDJARO	25	HAVANA NO. 2
2	BABILON	26	TWAHANGANA
3	OKAHANDJA PARK A	27	OUNONGO UOJE
4	OKAHANDJA PARK B	28	GREENWELL MATONGO D
5	OKAHANDJA PARK C	29	GREENWELL MATONGO C
6	ONGULUMBASHE NO. 2	30	ONELEYAFEWA
7	ONGULUMBASHE NO.1	31	AFRICA TONGASHILI
8	ONE NATION NO. 1	32	KAHUMBA KA NDOLA (A)
9	ONE NATION NO. 2	33	KAHUMBA KA NDOLA (B)
10	OKANTUNDA	34	HAVANA EXT. 2-5
11	SAMUEL MAHERERO	35	KAPUKA NAUYALA
12	OKANDUNDU	36	EPANDULO B
13	OMUTHIYA	37	OSHITENDA B
14	ONGHUWO YE PONGO NO.2	38	ERF 39, OKURYANGAVA
15	ONYIKA NO. 2	39	ERF 2327, OKURYANGAVA
15A	ONYIKA NO. 1	40	ERF 2326, OKURYANGAVA
16	OMURAMBA	41	HUIDARE
17	OMBILI NO. 1	42	HABITAT
18	FREEDOMLAND B	43	DIBASEN
19	FREEDOMLAND A	44	REHOBOTH GROUP
20	JONAS HAIDUWA	45	OUNONGO UOJE NGAUKUJAME
21	ONDELITOTELA	46	ONYIKA NO. 2
22	EUDAFANO	47	HAVANA EXT.6 & 7
23	HAVANA NO. 3	48	OTJOMUISE 1 & 2
24	HAVANA NO. 1		

Figure 10: Informal Settlements outside of Windhoek and Community Groups

Survey Questionnaires

We created interview questionnaires for the two target groups, community members and community leaders, with the help of a workshop given by Bertus Kruger of the DRFN. Following his advice, we performed several trial interviews before conducting our survey. Trial surveys were conducted in Havana number 1 (Group 24 in Figure 10), Freedomland B (Group 18 in Figure 10), and an area inhabited by illegal squatters, outside of Huidare (Group 41 in Figure 10). This allowed us to refine our survey questionnaire by omitting irrelevant questions and adding some that we had left out initially. It also allowed us to gain experience phrasing questions and eliciting complete responses.

Our survey questionnaire for community members was designed to gather information concerning the affordability of water, payment methods, and maintenance of facilities. Our survey also assessed interviewees' level of knowledge about water sources and costs associated with water distribution to determine if lack of education was a contributing factor to nonpayment. We inquired about household income to determine to what extent paying for water was a financial burden. We investigated the problem of nonpayment in communities using post-payment by asking direct questions concerning water pricing and the failure of others to pay. In communities that use prepayment, we asked questions to assess possible problems with the system. Since our background research and interviews revealed that one of the major problems with prepay meters is breakage and maintenance, we inquired about problems the users had with maintenance as well as how long facilities remained broken. Finally, we asked users how far away their nearest standpipe was in order to assess the distribution radius of each pipe. The survey questionnaire used for community members is available in APPENDIX F: COMMUNITY MEMBERS INTERVIEW QUESTIONS – KEY.

In addition to asking for opinions and views on their current payment system, we also asked community leaders questions that pertain holistically to the community. The survey questionnaire we used for community leaders is available in APPENDIX G: INTERVIEW QUESTIONS FOR LEADERS.

Performing Interviews

We used convenience sampling, which means our interview subjects were chosen based solely on availability, to gather responses within the selected

communities. We spent a morning (about 4 hours) in each of the aforementioned communities conducting surveys. On average, we gathered about 15 responses each morning.

It was very important to us that the answers we received from the community members were truthful and candid; therefore, we used three different measures to gain the trust of the community members.

First, the majority of our research subjects did not speak English as a first language. The most common local languages in the settlements are Otjiherero, Otjiwambo, and Afrikaans, and while some residents spoke English, it was their second or third language despite its status as the national language of Namibia. In order to effectively communicate with our interview subjects, we employed two translators through the DRFN: Ngula Niipele and Dennis Tjiueza. They functioned as an integral part of the interview process, helping us navigate the settlements and approach potential interview subjects. At the beginning of each interview, they introduced us and our project. They explained to the subjects that we were students working for the City in association with the Polytechnic and that their responses would be used for the benefit of the community. Some interview subjects were concerned that we were actually police trying to collect payment. In these cases, our translators showed the subject our student IDs and gave a more in-depth explanation of our project and relationship with the City. After our subjects had an understanding of our purpose, most were glad to talk to us and were pleased that the municipality was taking an interest in their problems.

Prior to the interviews, we spent a significant amount of time with our translators describing our project. We discussed the type of responses we hoped to elicit from each question as well as our motivation for asking it. This increased the efficiency of our interviews as our translators could provide more than direct translations of questions and responses, while being careful not to ask leading questions. When interview subjects were unclear about what a question was asking, our translators established a dialogue with them to explain the question and acquaint them with any unfamiliar concepts involved. Finally, when a subject indicated that he or she did not know where their water came from or why the City charged them for it, we asked the translators to describe the water sources and treatment processes as well as explain the City's need for cost recovery. While our survey was intended to

sample the breadth of knowledge concerning water issues, we felt that it was also important for us to provide some information to the curious interviewees.

Second, in order to gain acceptance by the community members, we had representatives of the Community Development office introduce us to the community leaders and explain the purpose of our research. The Community Development officers work closely with the community members on a daily basis addressing concerns and problems within the communities. They have gained the trust and respect of the communities through years of cooperation and understanding. After we were introduced by the Community Development officers, we were quickly invited into the shacks of the community members and had encountered very few problems conducting our surveys.

Finally, in order to illustrate, in some modest way, that we were in fact interested in the well being of the community, we brought crayons, coloring books, and candy with us so we could spend time with the children. As one person and one translator would interview a house, the other partner would color with the kids, ask them to write their names, and help them draw pictures. Although candy was a treat for the children, they were most excited over the books and crayons, and we had to buy more every afternoon for the next day's children. Overall we definitely received warmer welcomes and more open answers once we started interacting with the children. It was a very rewarding and memorable experience.

Point of Sale Office Survey

To supplement the responses we gathered from people in the prepay communities, we collected similar information from customers at the point of sale (POS) offices where water and electricity credit are purchased. These offices also collect the bills for land, post-pay water, and refuse removal. Two POS offices are located in Windhoek in the Wanaheda and Okuryangava areas of the informal settlements (see Figure 10).

The questions we used for the POS surveys were excerpted from the community members' survey. In order to minimize interview time while still obtaining relevant responses, we asked only the questions pertaining to prepay users: a total of ten questions. We chose to keep the POS survey short as our subjects would probably be in the process of doing errands and unwilling to answer a 30 minute questionnaire.

Cost Analysis

In order to determine the maintenance costs of the prepay meters we initially looked for service records. Although an initiative to record failures of meters was started in October 2004, the project was given a low priority and the records are incomplete. However, invoices listing the order date, type, quantity, and cost of replacement parts for the meters has been kept since February 2003. These invoices were used to extrapolate maintenance costs. While the invoices contain the cost of parts, additional information was needed to calculate the cost of labor and transportation.

We divided labor into two components: meter part replacement time and transportation time. The approximate replacement time for each meter part was provided by Mr. F. Carew. These times are shown in Table 2. The average round-trip travel time to the meters was estimated to be 15 minutes.

Table 2: Approximate Replacement Time for Prepay Meter Parts

Part	Replacement Time
Closer Assembly - Bernard Valves	30 min.
PC Boards	20 min.
Plungers	2 min.
Pulse Wires	15 min.
Solenoid Valves	5 min.
Solenoids	2 min.
Token Slots	5 min.
Valves	30 min.

All of the prepay meters are repaired by the Senior Water Meter Mechanic whose wage is N$50/hour along with an assistant who receives N$20/hr. The cost of labor to repair the meter for each instance was estimated by multiplying the sum of the two wages with the sum of the replacement and transportation times.

The transportation cost per repair was estimated by dividing the total transportation costs for fiscal year 2004 by the number of meter inspections and replacements that took place. These figures, obtained from F. Brinkman, are shown in Table 3

.

Table 3: Transportation Costs

Total transportation expenses	N$132,496
Number of Meter Replacements	916
Number of Meter Inspections	1450
Cost per incident	N$56

Three groups of meter installations took place during the course of the time period analyzed (February 2003 through April 2005). In order to properly calculate the average cost of maintenance per meter per month and mean time between failures, the invoices were divided into three groups corresponding to the installation dates. The cost of parts, labor, and transportation for each time period was calculated separately, divided by the number of meters present during the particular time period, added together, and divided by the total number of months. This yielded the average cost of maintenance per meter per month. Similarly, the number of replacement parts purchased in each time period was divided by the number of meters present at the time, added together, and divided by the number of months to yield the average number of failures per month. Taking the inverse (the reciprocal) of this number produces the mean time between failures in months. The average cost of maintenance per meter per month and the mean time between failures are shown in Table 6.

Using the average cost of maintenance per meter per month along with the purchase and installation cost per meter (N$2,526.80, obtained from F. Carew), we extrapolated the average total capital and operational cost per meter over 10 years. This was accomplished by dividing the purchase and installation cost by the number of years and adding the average cost of maintenance per meter per month multiplied by 12.

In order to establish a basis of comparison for the prepay meter service costs we obtained data to calculate the average cost per meter per month of all meters maintained by the municipality. Using figures for the costs of parts, labor, and transportation, as well as the total number of meters in the City, as shown in Table 4: Meter Services Figures for Windhoek, we calculated the average cost of maintenance per meter per month.

Table 4: Meter Services Figures for Windhoek

Parts expenses	N$1.35M
Labor expenses	N$2.29M
Transportation expenses	N$132,496
Number of meters	44,312

CHAPTER 4: RESULTS

Surveys were conducted in two post-pay communities, Africa Tongashili and Havana numbers 1 and 2, two prepay communities, Okuryangava and Havana extensions 2-5, and lastly at the Okuryangava point of sale office. We collected survey responses from 59 community members in the informal settlements and ten at the point of sale office. This yielded a total of 37 responses from prepay users and 32 responses from post-pay users. Despite this statistically small sample, our results display clear trends which we believe reflect some of the dominant opinions and attitudes, in the settlements, towards water payment.

Surveys: Community Members and POS Customers

We designed our surveys to assess various water related issues that were identified in the communities. Namely, we investigated five main areas concerning water distribution and management including affordability, costliness, post-pay and prepay metering systems, maintenance, and water scarcity. The full questionnaire and key can be found in APPENDIX F: COMMUNITY MEMBERS INTERVIEW QUESTIONS – KEY. The following is a summary of our most important observations.

Income and Water Expenditure

To assess the affordability of water in the communities, we examined household income and water expenditure. We analyzed the data in terms of individual communities, prepay users, post-pay users, and all residents surveyed. We calculated figures of average income and expenditure, and the average percentage of a household's income for each grouping. Table 5 displays the averages computed for the seven various groupings of community members: the four individual communities plus the three aforementioned categories.

Table 5: Average Income and Expenditure Figures

Category	*Income*	*Water Expenditure*	*Water Expenditure as Percentage of Income*	*Water Expenditure per Household Member*
Africa Tongashili	N$353.22	N$77.00	40.1%	N$22.47/person
Havana no. 1&2	N$630.00	N$85.00	18.0%	N$20.66/person
Post-pay	N$491.61	†	29.1%	N$21.57/person
Havana ext. 2-5	N$713.75	N$37.75	5.6%	N$11.57/person
Okuryangava	N$1,116.67	N$36.24	4.5%	N$10.14/person
Prepay	N$915.21	N$36.99	5.1%	N$10.85/person
All	N$703.41	†	17.1%	N$16.21/person

To better illustrate the distribution of incomes we gathered, box and whisker plots (see GLOSSARY AND ABBREVIATIONS) were created. The three graphs that follow in Figure 11 are box and whisker income plots for the prepay sample, the post-pay sample, and the entire sample.

† Since water expenditure is fixed in post-payment communities, we chose to omit the data of average post-payment expenditure and average overall expenditure.

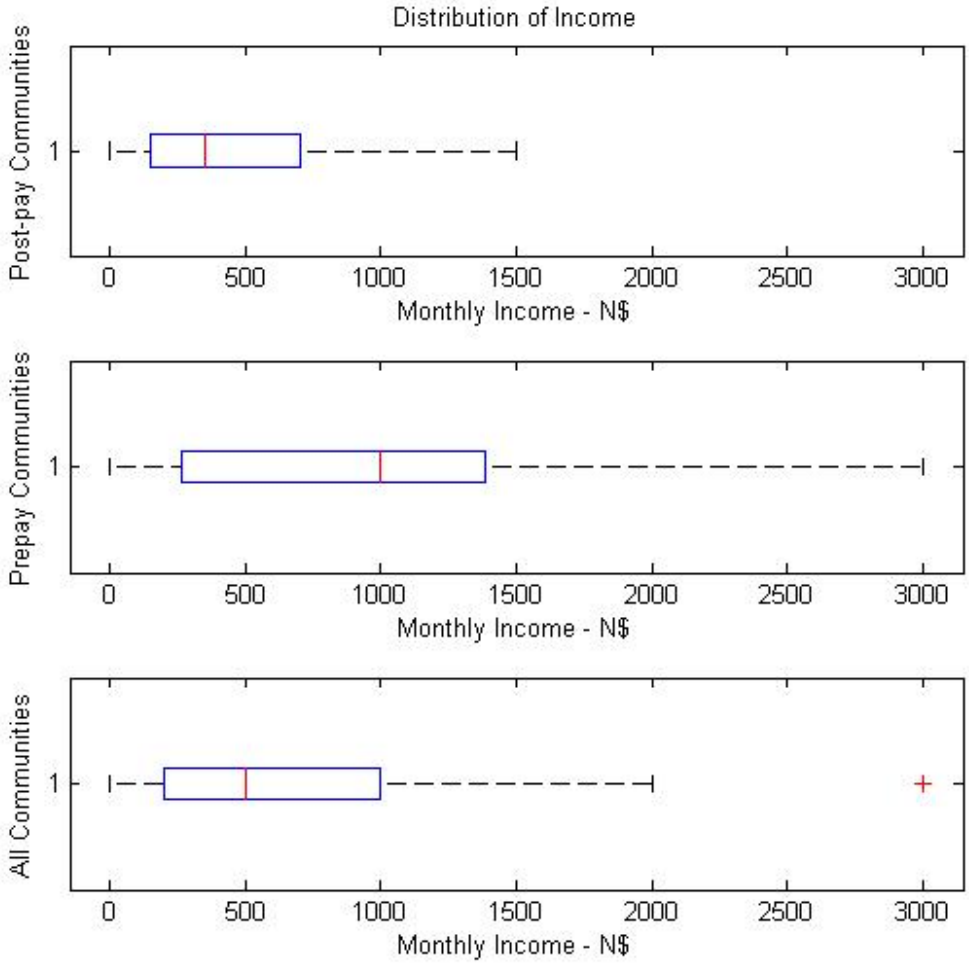


Figure 11: Distribution of Income

The Costliness of Water

One of our survey questions was designed to determine if community members view water as being too expensive. Of the 59 community members surveyed, 47 percent felt that water was too expensive. Of those who felt water was too expensive, 89 percent were from a post-pay community and only 11 percent were from the prepay communities. This information is summarized in Figure 12.

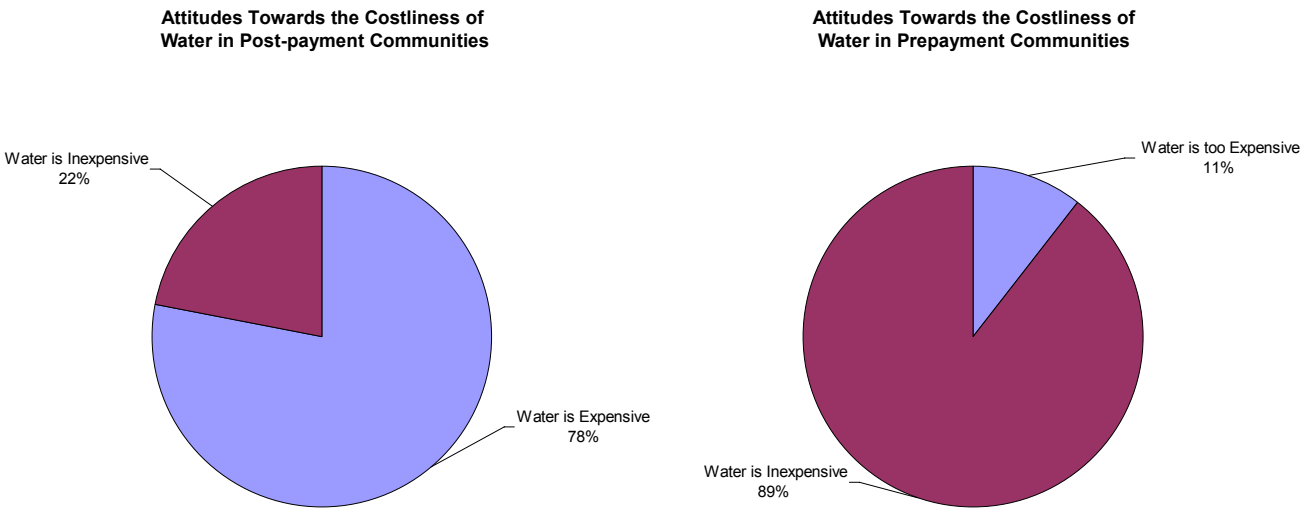


Figure 12: Attitudes Towards the Costliness of Water in Post-pay and Prepay Communities

Those who thought water was too expensive were asked what they felt would be a reasonable price. Twenty of the residents gave numerical responses, with the average price being N$35.50, and five of the residents asserted that the only reasonable price would be with a prepay system.

Problems with Paying for Water

When asked to identify their main problem with paying for water, 41% of the 32 people surveyed in the post-pay communities identified the costliness of water as their main problem. Other problems identified included the issue of nonpayment, and the problem of broken standpipes as observed in Figure 13. In addition, eleven people asserted that they had no problems with paying for water.

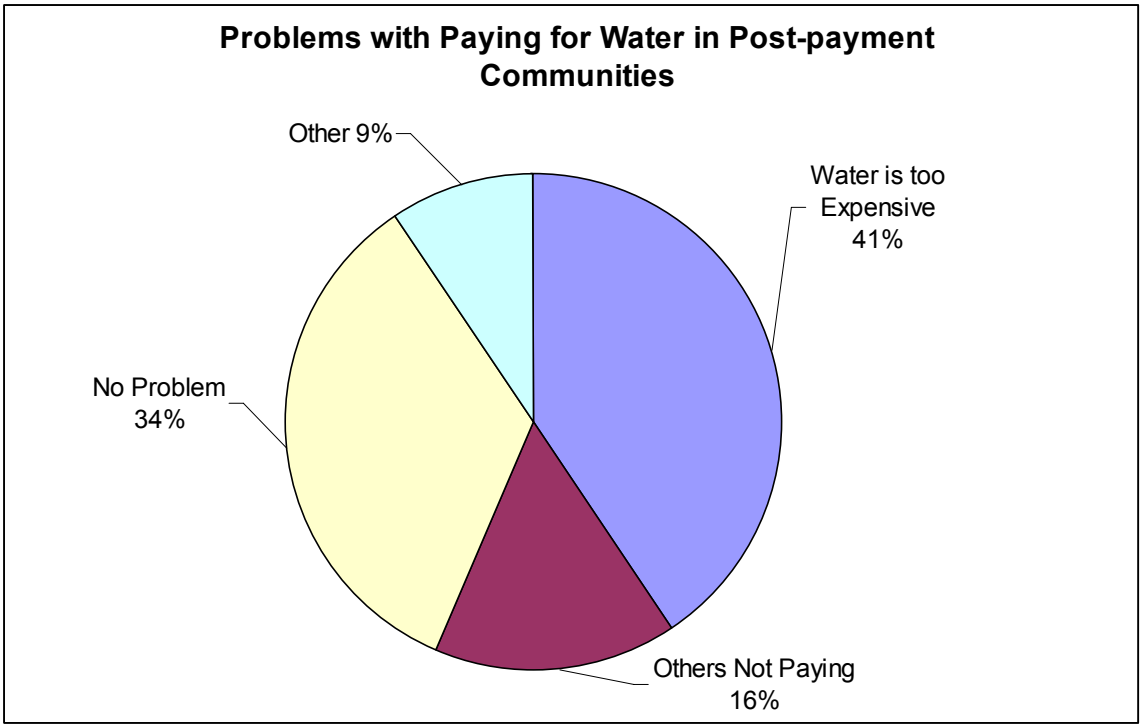


Figure 13: Problems with Paying for Water in Post-pay Communities

In the prepay communities, identifying a central problem with paying was more difficult. Of the 27 residents surveyed, 17 expressed that they had absolutely no problem with paying for water, as depicted in Figure 14. Unlike the 13 people who thought water was too expensive in the post-pay communities, only 6 people in the prepay communities identified the cost of water as their main problem with paying for water. Other residents also stated that their main problem was associated with the malfunctioning of the prepay meters.

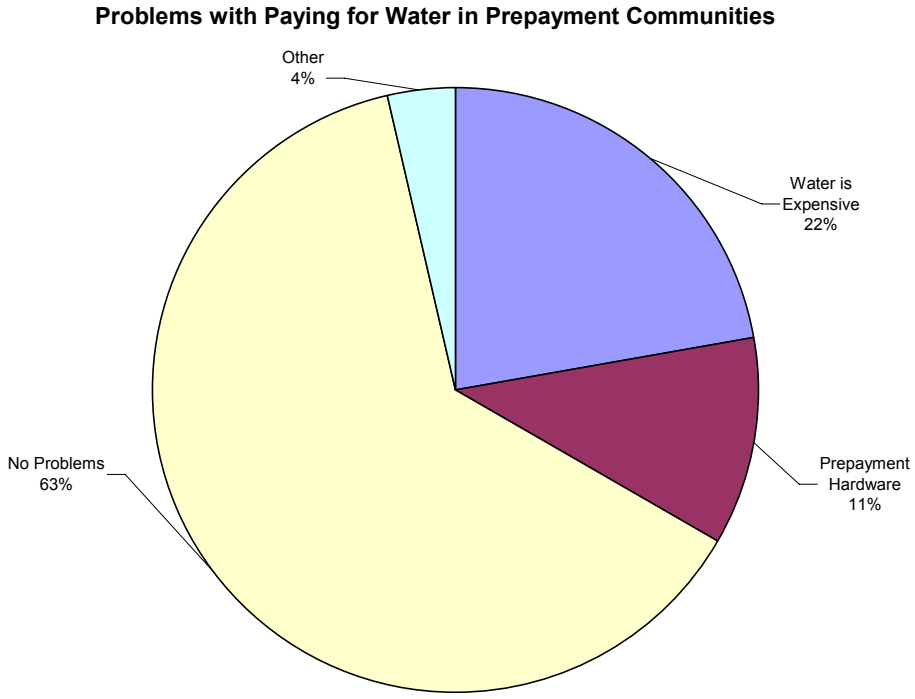


Figure 14: Problems with Paying for Water in Prepayment Communities

Post-payment

Our assessment of the post-pay community focused around the problem of nonpayment within the community, the notion of a penalty for nonpayment, and the possibility of prepay metering within the communities. We approached people in Africa Tongashili and Havana Extensions 1&2 in order to gather opinions about these issues.

When we asked community members about nonpayment and we found that almost everyone thought it was unfair to the rest of the community. The majority of community members stated that they make very little money and still struggle to pay while some people who don't pay receive higher incomes. Concerns were also voiced over the probability that the people who don't pay cannot afford to pay. Notably, we cannot be sure that some of the people who claimed that they paid for water were not in fact among those who did not.

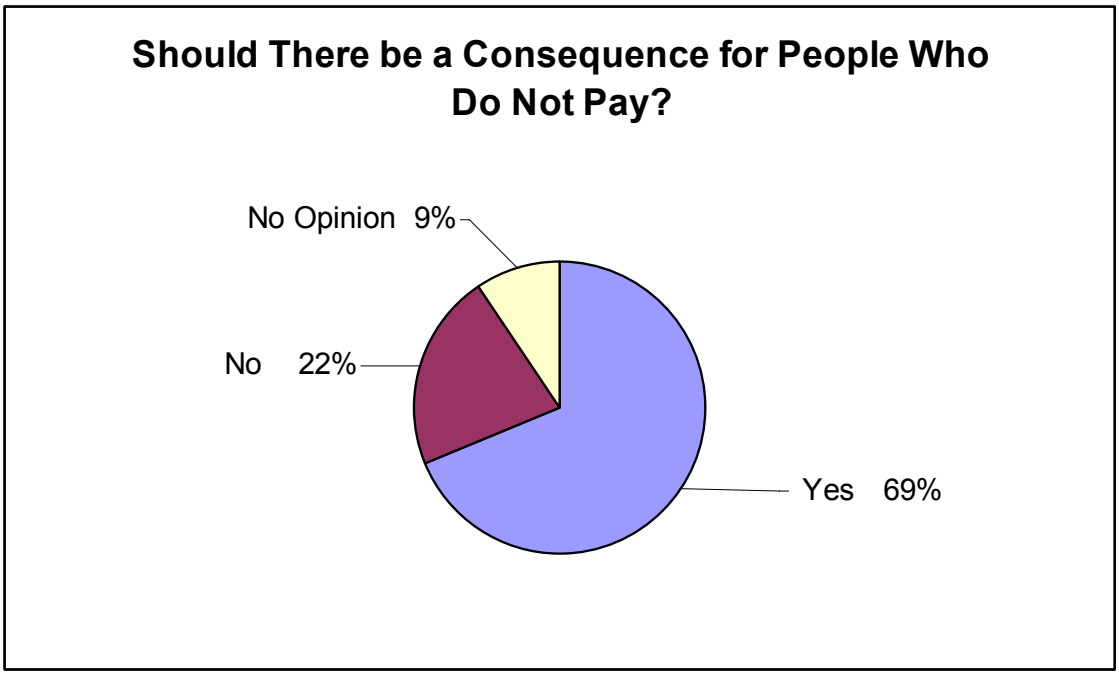


Figure 15: Should There be a Consequence for People Who do not Pay

We then asked if people who do not pay for water should have to face a penalty or consequence, we were met by a strong affirmative response as depicted in Figure 15, above. However, when we probed further into what kind of penalty should be imposed, it was often suggested that the communities get together in a meeting to discuss the issue and work out a solution. Although everyone agreed that nonpayment is unfair to the community, there was a strong concern for people who cannot afford to pay and it was obvious that the communities did not want to punish these people but rather work with them.

We then asked post-pay community members if they had any ideas to solve the problem of nonpayment, and a strong number brought up prepayment as a possible solution. Overall 84% of the post-pay users had some knowledge of the prepay system, and the rest had never heard of it. After we thoroughly described the method of prepayment including the credit system, cards, and associated problems, we asked the post-pay communities how they felt about the idea. Every community member surveyed said that they would prefer the prepay system over the post-pay system for a variety of reasons. Primarily, the majority of those surveyed identified a sense of responsibility with the prepay meters, stating that you can recharge whenever you have money, and you can monitor how much water you use and therefore how much you have to pay. As well, six people specifically identified prepayment as a

solution to nonpayment and six people identified prepayment as a cheaper option to post-payment.

Prepay Communities

Our initial concerns for people in the prepay communities were with the problem of people running out of credit and being unable to get any water. We also probed deeper into how much money they used to purchase credit, how often and at what times they purchased that credit, and if they had any specific praises or problems with the prepay system. In order to gather a variety of survey samples, we approached two prepay communities; Havana 2 though 5, Okuryangava erven 2326 and 2327, and a POS office where we surveyed people as they were purchasing their water credit.

A major concern with the prepay system is that when people run out of credit on their card, they are unable to obtain water from the communal standpipes. Of the 37 people we surveyed who are currently using the prepay system, we learned that 54 percent of them had experienced this problem resulting in their inability to get water. Those that expressed a problem claimed that they usually ran out of credit on Friday or over the weekend when the POS offices are closed, which prevented them from adding more credit to their card. In addition, when asked how often this happens, over half of the respondents claimed that it happened once a month or less when it came time for them to refill credit.

In contrast, another 16 of the surveyed community members claimed they had never run out of credit. Some of them stressed that they always carefully monitored their credit balance and made a conscious effort to add credit before the weekends. In the cases where people did run out of water for any amount of time, every member surveyed claimed that they were provided water from family, friends, and other community members until they were able to recharge their cards.

When asked how often they purchase credit on their meter cards, 62 percent of people surveyed claimed they went more than once a month to the POS office. A further breakdown is illustrated in Figure 16.

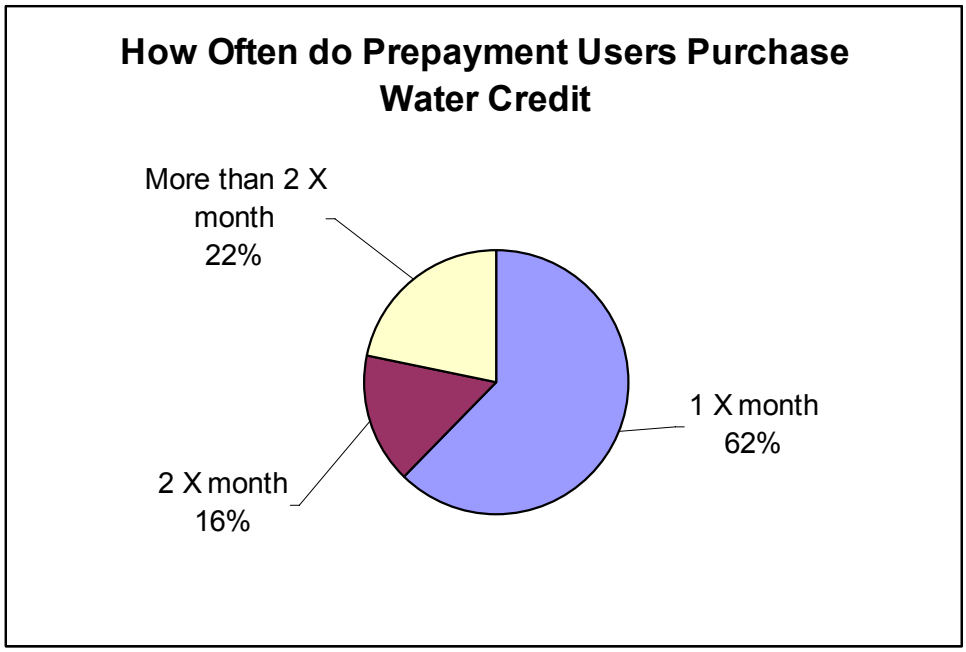


Figure 16: How Often do Prepay Users Purchase Water Credit

We then asked the community members if they have experienced problems with the times they could go to the POS office to purchase credit, and learned that 86% of the 37 surveyed community members did not find the available times inconvenient, while 14% found the time very inconvenient. We asked all 37 people what times they would prefer to purchase water credit, and the results are depicted in Figure 17.

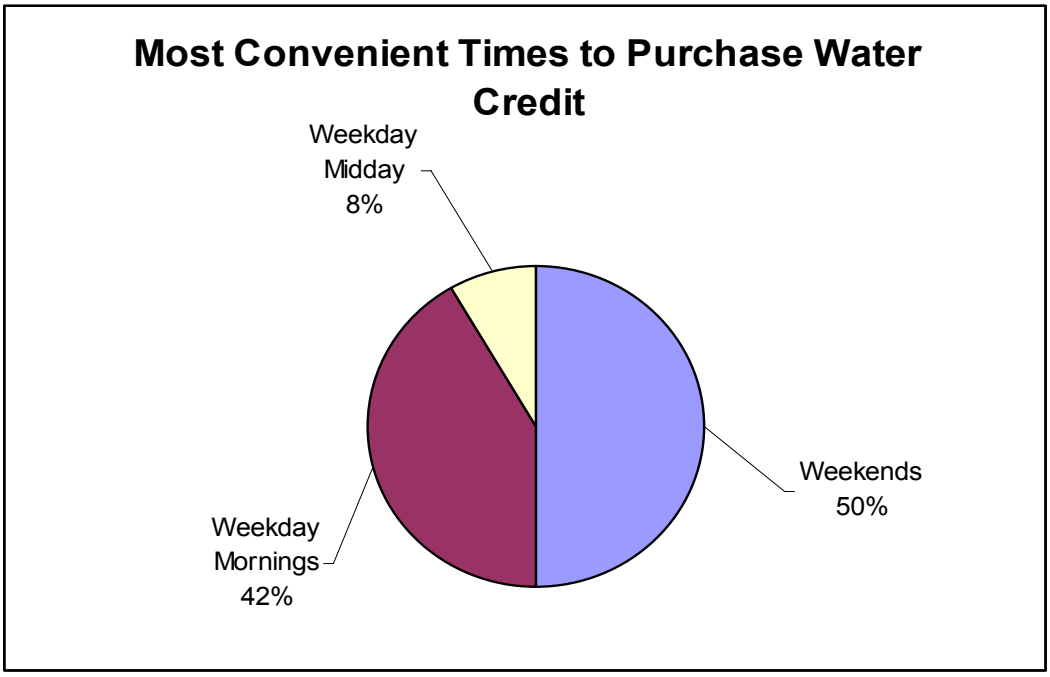


Figure 17: Most Convenient Times to Purchase Water Credit

When people were asked if they liked anything specific about the prepay system, 50% of people surveyed claimed that they found the system good for various reasons. Namely, they pointed out that the prepay system results in individual responsibility, while the post-pay system puts the burden on the community as a whole. They asserted that with prepayment, credit can be added to a card whenever one has money, and that the money spent on water will only be used by the purchaser and his or her family. In addition, they emphasized that monitoring how much money is spent on water makes it easier to control how much water is used. This is supported by the community's assertion that the prepay system is less expensive then the post-pay system, where residents receive a set monthly bill regardless of their individual water consumption.

We then asked people if there were any additional problems they had encountered with the pre-pay system. There was a strong concern expressed over broken meters. When meters break not only do residents have to walk longer distances to the next functioning meter, but also broken meters have been known to completely erase credit from prepay cards. In addition, people identified lost or stolen cards as a large problem, stating that since the prepay cards are not marked, it is impossible to track them down. Moreover, when a card is lost or stolen it is very

expensive to purchase a new one. The hours of operation of the POS office and its distance from their residence was also identified as a problem with the prepay system. Finally, three people expressed concern over the expense of water, asserting that they really could not afford to purchase a basic amount of water through the prepay system.

In order to engage the community in our recommendations, we probed the prepay community members for possible solutions to the problems they identified. Although only a small percent of those surveyed offered their opinions on this matter, their answers were encouraging. Primarily, many people reiterated their concern over broken standpipes and stressed that these problems must be addressed in a timelier manner. It was also suggested that the municipality reimburse people for the credit lost on their card when a meter malfunctions, and that a tracer be put on the payment card for if they are lost or stolen.

Maintenance

The communities were also surveyed to determine the nature of problems with facilities (standpipes, meters, or toilets). Of the residents surveyed, 81 percent said they had problems with broken facilities. Namely, 76 percent of the residents reported issues with toilet facilities. These problems included clogged toilets, toilets without doors, leaking toilets, toilets without water, and locked toilets. Some residents reported that they had no problems with the toilets. However, after asking these residents why they had no problem, with the toilets, they would later divulge that they were the ones locking the toilet and that they had keys. Also, 32 percent of the residents surveyed reported various problems associated with standpipes such as leaking standpipes, broken meters, and standpipes not delivering water. Figure 18, below, exhibits the frequency that each of these problems was reported.

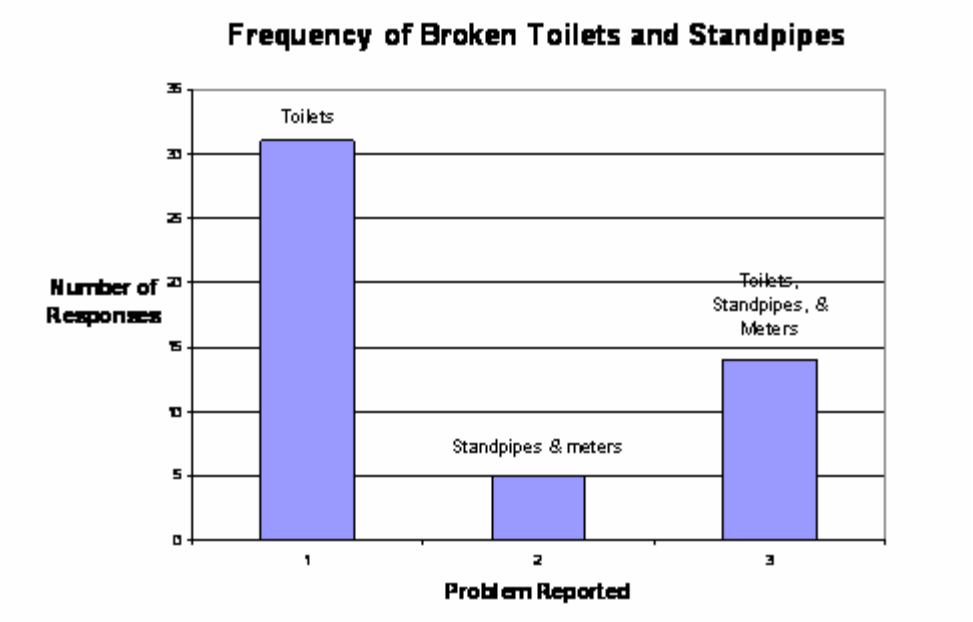


Figure 18: Frequency of Broken Toilets and Standpipes

We further investigated the causes for the broken toilets and standpipes and observed that the reason for each malfunction was different in the various communities. For example, of the 15 people in Africa Tongashili who reported problems with toilets, ten of them said it was due to the water tap being shut off. As well, in Okuryangava all of the community members surveyed reported problems with facilities, ten of which reported vandalism for the reason for this breakage.

Distribution

The average distance between the shacks of the people we surveyed and the nearest standpipe is 38 meters. The maximum distance was 200 meters, and 17 percent of people surveyed had to walk more than 75 meters to obtain water.

Water Sources

Survey questions were posed to determine the community's level of knowledge in regard to why the City sells water, where the water they drink comes from, and why and if it is necessary to conserve water. When asked why the City sells water, 53 percent of the 59 surveyed residents had no understanding of why water must be sold, while the remaining 47 percent of residents had varying degrees of understanding. Some of the responses of community members who did not know why the City sells water were that "they [the City] are the boss," "there is a law that says we have to pay for water," "Water is life," and simply "I do not know." Of those

who had a good understanding of why they had to pay for water, their responses conveyed a comprehension of the fact that water costs money to recycle, clean, and distribute. The residents who had a good awareness of why they were paying for water also appreciated the fact that the money they are paying is going to the maintenance of infrastructure.

Another measure we used to determine if residents knew why they were paying for water was to ask them where they think their water comes from. Of all of the community members surveyed only 20 percent had a good understanding of where their water came from, while 37 percent had somewhat of an understanding, and the remaining 42 percent had no idea where their water came from. An example of a response that shows a good comprehension of where the water comes from is, "Water comes from the Goreangab Dam, mixes with water from Gammans, and is recycled." A response that we consider to show satisfactory understanding was "The water comes from the Dams." Responses that showed poor understanding included "No idea," "Rain," and "The ground."

Our final survey question was aimed to determine if members of the informal settlements realized the importance of water conservation due to the severity of the water scarcity problem in Namibia. We were encouraged to learn that only three people surveyed felt that it was not necessary to conserve water, while the remaining 54 residents contended that water conservation is important. Many people responded that the scarcity of water alone is enough of a reason to conserve, as they wanted to make sure that they would never run out of water. However a strong majority of those surveyed cited the expense of water as their primary motivation. They noted that the more water they consume, the more they will have to pay. Figure 19, below, displays different community opinions of why it is necessary to conserve water.

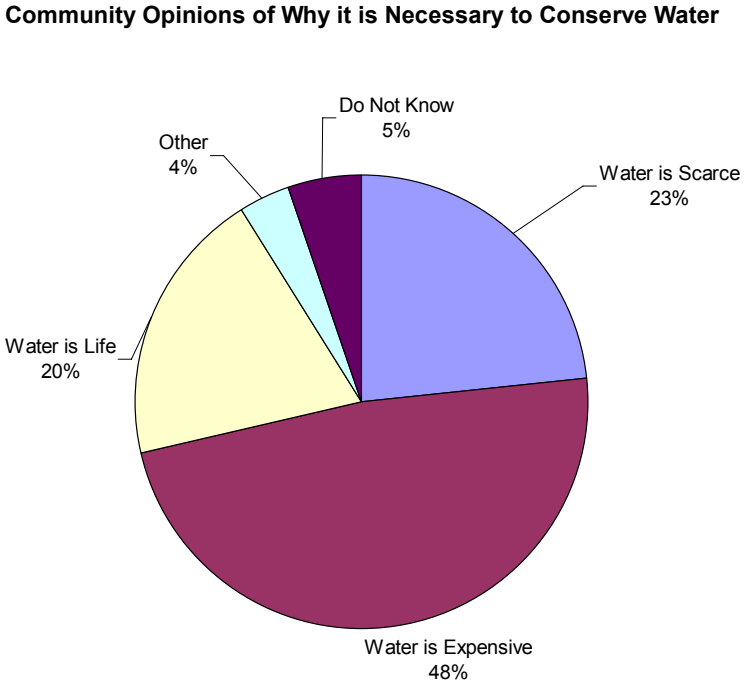


Figure 19: Community Opinions of why it is Necessary to Conserve Water

Demographics

To gain an understanding of the lifestyle of the residents we asked them for some general information. Of the 69 people we surveyed, including those surveyed at the POS office, 43 percent were male, 51 percent were female, and 4 percent of our surveys were completed jointly by a male and a female.

It has been alleged that people are not paying for water because they did not have to pay for water before they moved to the City. In order to determine if this correlation exists, we asked questions pertaining to the origin of the residents and their previous water systems. We asked the 59 community residents how long they had been living in the City and learned that five people had moved to Windhoek within the last year, six people had moved within the last three years, and the remaining 48 people surveyed had lived in settlements for more than three years. The majority of residents surveyed, 73 percent, originated from rural areas while the remaining 27 percent had moved from another informal settlement or other village. We also discovered that 63 percent of residents surveyed did not pay for water before they moved to the City, which might account for any current resistance towards water payment.

Our survey data revealed that the average household size in the post-pay communities surveyed was 4.5 people and the average household size for the prepay communities was 4.2 people. The difference between the community's household sizes is very small and the overall average in the four communities is 4.3 people per house.

Finally, in order to establish the financial security of residents' income in the informal settlements, we asked them about their employment status. Of the 59 people surveyed within the communities, 70 percent of the residents were employed, 59 percent of whom were self-employed. Common jobs of the self-employed residents included store owner and seller of meats, traditional drinks, and traditional dresses. The remaining 30 percent of residents surveyed were unemployed.

Cost Analysis

The average cost of maintenance per meter per month and the mean time between failures are shown in Table 6.

Table 6: Summary of Cost Analysis

Average cost of maintenance per prepay meter per month	N$20
Average cost of maintenance for all meters per meter per month	N$7
Mean time between prepay meter failures	9 months, 3 days

An extrapolation of the capital and operational expenses of a prepay meter distributed over 10 years is shown in Figure 20.

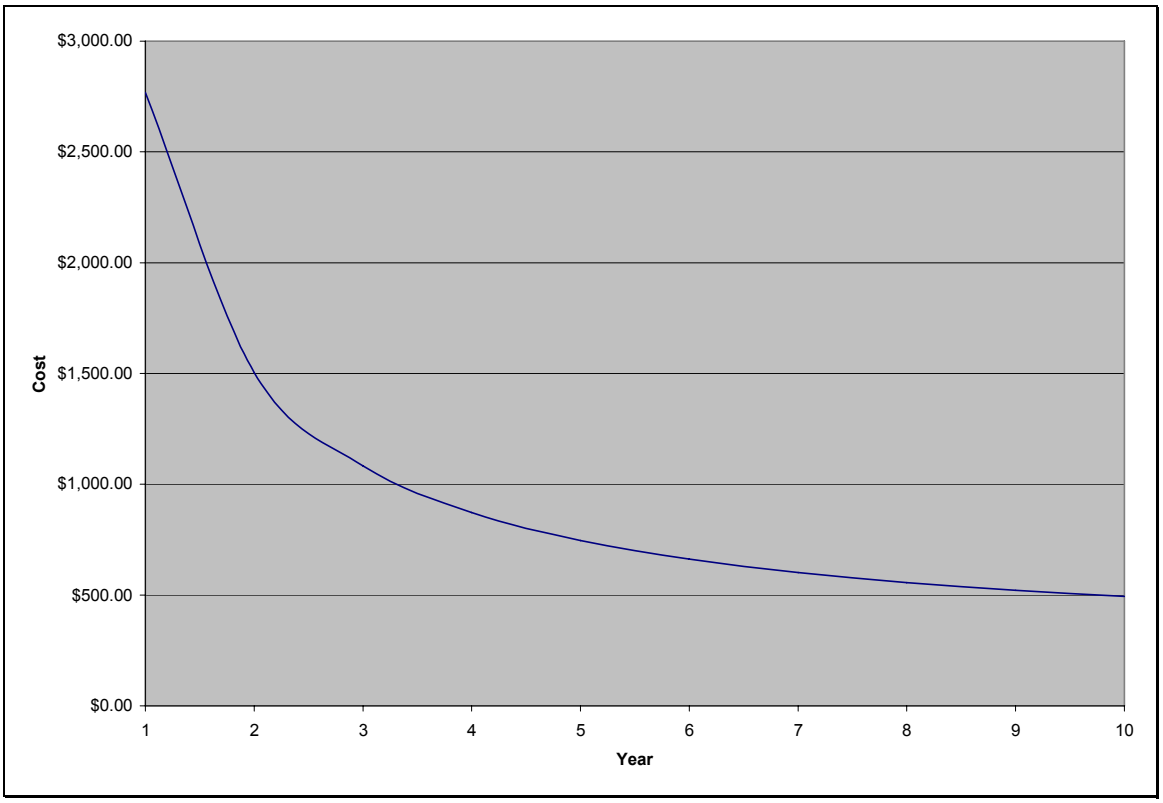


Figure 20: Total Cost of a Prepay Meter over Ten Years

CHAPTER 5: DISCUSSION OF FINDINGS

Analysis of our survey data establishes prepayment as a better alternative to post-payment. Prepayment proves to be both more affordable and more equitable, while it solves other problems associated with post-payment such as nonpayment. Further investigation also demonstrates that problems identified with prepayment are not as severe as once thought. Problems associated with meter breakage and the proximity of the point of sale location could be remedied with a more extensive implementation of the prepay system. Moreover, the cost analysis displays that the maintenance and capital cost of prepay meters are reasonable. Although prepayment is superior to the post-pay system, it is necessary that the subsidy schemes be revaluated to guarantee that no one is left without water.

The Affordability of Water

The issue of affordability is very important to consider when dealing with a life necessity such as water. Water must be financially accessible to all people. For this reason, we investigated the affordability of water in the communities we surveyed.

In the communities we surveyed, an obvious trend arises that those who use the prepay metering system pay much less for their water. One can see from Table 5, in the previous chapter, that the average water expenditure in the prepay communities is less than half of that in the post-pay communities. This is no doubt due to the fact that, in compensation for nonpayment, the water bill each household receives in post-pay communities is actually greater than the average water usage divided equally by the number of households. It is obvious that this billing system is unfair because it charges residents for more than their actual usage. It is understandable that since there is no individual metering that the total bill must be divided equally within the community, which is arguably inequitable in itself; however, charging extra for the failures of others to pay.

Table 5 also shows the average water expenditure as a percentage of income in the communities we surveyed. This effectively shows the financial burden that water costs place on the individuals, which is clearly much less in prepay communities than it is in post-pay communities: an average of 5.1 percent of income as compared to

29.1 percent. The World Water Council estimates that an urban household is only able to afford up to 5 percent of its income for water services (Winpenny, 2003). Obviously, in the case of the post-pay users we surveyed, their water expenditure is largely disproportionate to their income.

This problem can fundamentally be rectified in two ways: either reduce water prices or increase the average household income. Simply reducing domestic water prices in lower income areas requires that another water user must subsidize this consumption since water costs must be recovered by the City. This, however, will not necessarily alleviate the problem of non-payment in the settlements. If individual metering were instituted with prepayment, water prices will be reduced from the standpoint of the end user and revenue collection would increase for the City. Alternatively, increasing the average income can also lessen this financial burden; however, this becomes a complex problem compromising socio-economic development and poverty alleviation, which cannot be addressed here.

Water expenditure was also compared to household size in order to obtain a figure that illustrates the relative cost of water without considering income. We calculated this figure because while average income varied substantially from one community to the next, average household size was relatively constant: about 4.3 persons per household in all cases. Once again it is apparent that the burden of water pricing is felt most by the members of the post-pay communities where the average expenditure per month per person was about twice as much as in the prepay communities.

Throughout the interviews, both community leaders and community members commented on the issue of non-affordability. Without being specifically asked, many people noted that water is too expensive for some people. Those without jobs or steady incomes, truly the poorest members of society, have trouble paying for water. If prepayment were expanded to more communities, measures would have to be taken to ensure that water is financially accessible to all. The prepay system in the informal settlements currently does not have any preventative measure to ensure that those who cannot afford water aren't denied access. The prepay system could, however, be modified so that a baseline amount of water is free. Further investigation into water pricing and subsidy possibilities is discussed in the recommendations section of this report.

Although our sample size is small in comparison to the current population of the informal settlements of Windhoek, our survey data clearly shows the trend that prepayment is much more economical for residents. In summary, water prices are roughly halved from the perspective of the consumer and the percentage of income spent on water is much less in prepay communities. Also, some interviewees noted that affordability is a very large problem for the poorest people, which is a problem that urgently needs to be addressed.

Opinions Regarding the Costliness of and Payment for Water

The previous section illustrates that water is more expensive in post-pay communities than in prepay communities. In our questionnaire, we asked what the peoples' opinions and attitudes are regarding the issue of the costliness of water as well as if residents believe that they should have to pay for water.

As can be expected, the responses from post-pay and prepay users clearly differ when the question of costliness was asked. The majority of people in post-pay communities believe that water is in fact too expensive. When asked this question, some of these people noted that sometimes it is very hard to come up with enough money to pay for their water bill and that currently the system is inequitable because those who pay are not necessarily the ones with more money. This again highlights the flaw with the current post-pay metering scheme that there is a lack of individual responsibility and of payment enforcement. Also, since everyone is charged the same amount, those who struggle to pay have nothing to gain by monitoring their usage and attempting to conserve in order to save money. The majority of people in the prepay communities, conversely, do not think that water is too expensive. These results agree with the figures in the previous section that illustrate the difference in expenditure as a percentage of income. All people deserve water at an affordable price regardless of income; however, the current post-pay system in place in the informal settlements is not affordable for all. The prepay system is not only a remedy to this but is also a fairer system.

Of the people we surveyed, 59 percent stated that they did not have to pay for water before they moved to the City. The problem of nonpayment suggests the possibility that people do not pay their water bills because they don't believe that they should have to. We tested this possibility with a question that asks explicitly if people think that payment for water in necessary. A large majority, 93 percent, asserted that

payment for water is in fact necessary while only seven percent thought that water should be free. Of those who agreed that payment was necessary, two common reasons for why this was so were: that the City needs to maintain infrastructure and pay for treatment and that "water is life." In other words, the people don't mind paying for water as it is a life necessity. The responses gathered in response to this question suggest that the majority of people respect that there is a cost associated with the provision of water and also do not mind paying for this resource. This indicates that prepayment is a viable and socially acceptable alternative to post-payment since most people do not disagree with the fact that water should be paid for.

Problems Identified in Post-pay Communities

Our survey demonstrates that the post-pay system is neither desired nor accepted by the majority of residents using it. Members of post-pay communities have almost unanimously agreed that the current system is unfair, and they have, in fact, unanimously agreed that they would prefer the prepay system.

As described in the previous chapter, residents feel that the problems associated with the post-pay system are severe. The most significant problem identified by the residents in the post-pay communities, besides costliness, is the lack of payment by others. Of course, nonpayment directly correlates to water costs since inadequate collection of funds increases the price for water. One can argue that these two problems are, in fact, singular because one is a direct consequence of the other. By this reasoning, nonpayment is the central issue in post-pay communities. The matter of nonpayment has caused much controversy and animosity among community members as it is felt that those who do not pay are not necessarily those who cannot afford to pay.

Prepayment presents a solution to the problem of nonpayment in that it guarantees that residents are paying for water. Also, it assures that no one has to pay for any other's usage, only one's own. Some residents were concerned that they are letting their communities down because they do not always have money when their monthly bill is due. With prepayment, users can put money on their card whenever they have money, alleviating the concern of some residents. These benefits of the prepay system would create feelings of justice and equity among residents of the informal settlements.

Distribution

While the distribution of standpipes appears to be adequate, the distance to the nearest standpipe reported by some users was higher than ideal. An assessment of the current distribution of standpipes could identify locations that require additional standpipes. However, when a standpipe or meter breaks, the number of standpipes is effectively reduced, forcing many users to walk greater distances to obtain water. This increases the importance of adequate distribution so that water is still accessible when a meter breaks.

Advantages and Disadvantages of Prepayment

Although prepayment has been identified by both its users and post-pay users as a good system, it does present its own limitations. Some of the problems identified with the prepay system are related to water credit. The survey data indicates that there is a problem with users running out of water credit and being unable to obtain water. Although a majority of the users have run out of water credit, at some time, when further investigated, it becomes apparent that these users were not completely denied access to water. All of the residents who ran out of water found other means of obtaining it, such as borrowing water or water credit from a neighbor, friend, or family member. The data also shows that those who monitor their credit regularly do not run out of credit. Of course, the number of users who run out of credit would be significantly reduced if water credits were more carefully monitored.

A disadvantage that we originally identified was that the point of sale (POS) office is only open on weekday mornings. We suspected that this might be inconvenient for prepay users and that it might prevent people from obtaining water credit. When we asked if the limited hours of operation of the point of sale location were a problem, the majority of users said that it was not. This reveals that although the hours of operation do prevent users from purchasing water credit on the weekends, it not the reason why users are running out of credit. When asked, however, about what times would be most convenient, many prepay users identified weekends.

Prepay users identified other problems with the metering system such as broken meters, lost or stolen cards, and the distance to the point of sale locations. These problems are rooted in the fact that prepayment is a new program, only in its pilot stages. Because prepay meters are a relatively new technology, they still have many problems associated with the electronics. It can be assumed that a larger

demand for these meters would cause the technology to improve, creating a more robust meter. By improving the technology, problems other than meter breakage could be addressed. A feature could be added to prevent cards from being stolen. If a personal identification number (PIN) number were added to each card, residents would not have to worry about others stealing and using their card. Another problem associated with the novelty of the prepay meters is the small number of point of sale locations. This problem was brought to the attention of Mr. Piet du Pisani, head of the Department of Infrastructure, Water and Technical Services (See

APPENDIX E: INTERVIEWS). Mr. Pisani asserted that expanding the number of locations and having prepay water credit sold at other locations, such as convenient stores, would not be very complicated. He explained that this expansion has not yet taken place because the prepay system is still in its piloting stages and has not been fully implemented. If the prepay system were fully endorsed many of its problems would, in time, become less severe.

Although residents of prepay communities and post-pay communities recognize the problems associated with prepayment, they maintain that they prefer this system. Residents feel that the advantages of the prepay system outweigh its disadvantages. The preference of the residents establishes that although this system has its problems, the severity of these problems is not as great as those associated with the post-pay system.

Water Pricing and Subsidization

There is a clear need for subsidization with the prepay system. The post-pay system does present a benefit in that no member of a community can be forced to go without water. In the post-pay system, if a resident cannot afford to buy water, he or she is subsidized by the rest of the community's payment. Although this system is inequitable, in that some residents are being subsidized by their peers, the system does not disallow anyone access to water. With the current prepay system, there is no way to obtain free water. Interviews with the community leaders and surveys of the community members make it apparent that there is a portion of the community that cannot afford to pay for water even if it is cheaper with prepayment. Therefore, before prepayment can be further promoted within the informal settlements, it is imperative that subsidization schemes first be reconsidered to ensure that no resident will be cut of from their water supply.

Primarily, a free baseline could be established to provide a basic amount of water at no charge to residents who cannot afford to pay. Beyond this level of consumption, the price for water could be just above the cost recovery price to subsidize the free consumption without being penalizing. If the free baseline policy were implemented, it would have to be provided to all domestic users for the sake of equity.

Secondly, a life line policy could be instituted to ensure that if users run out of credit on their prepay cards they will not be denied access to water. The life line will

provide a small amount of water to meet basic requirements, and the price of this water will be debited on the card and removed from the next credit purchase. This life line will act as a "safety net" for prepay users if they fail to properly monitor their credit or plan their credit purchases accordingly.

Finally, the municipality of Rehoboth has instituted a universal tariff with rebate (UTR) system whereby residents are refunded a portion of their monthly water payment depending on their consumption. This refund for the amount of $15m^3$ is provided to all citizens, not just the poor. However, it is mostly the poor who have to carry their own water buckets who meet the $15m^3$ requirement, and who receive the most benefit. Once they receive their refund for the month, they can recycle that money to pay the next month's bills until they receive the next refund. This system also encourages conservation of water because the subsidy is determined by water usage and not by income (conversation with Van der Merwe).

Costs Associated with Prepay Meter Maintenance

The cost of maintenance for the prepay meters is about three times the cost of the average meter in the City. This can be attributed to several factors. Many of the meters in the City service single family households and receive much less use and wear than the prepay standpipes which service tens of families. In addition, the design of the prepay meter is relatively new. In the beginning of the pilot study, the meters broke much more frequently. As the design matured, the meters have become much more robust and require less frequent service (conversation with F. Brinkman, 2005). The mean time between failures for the prepay meters is fairly high.

While the prepay meters require frequent service and high maintenance costs, the higher cost recovery allowed by the prepay system can likely compensate for these costs. In addition, the current trend in meter technology development indicates that the meters will continue to become more reliable and cost less to maintain. Furthermore, in our opinion, the ability to ensure that everyone is charged an equitable amount for their water consumption is worth the extra effort and expense.

CHAPTER 6: RECOMMENDATIONS AND FUTURE RESEARCH

The prepay meter pilot program should be expanded to more communities within the informal settlements.

Non-payment is a significant problem within the post-pay communities and many residents in the post-pay communities identified prepayment as a solution to nonpayment. Every resident surveyed said they would prefer prepayment over their current post-pay system. We therefore recommend that prepay meters be installed in more communities. Prior to installation, the prepay system should be explained and approval should be solicited from the communities.

A community monitor should be hired within each community to monitor the standpipes and metering systems.

There is a strong concern in the communities about broken standpipes. When a standpipe is broken, people have to walk further from their residence to retrieve water from the next closest standpipe. In order to ensure that water is accessible to all residents, it is imperative that problems with broken standpipes and meters be addressed in a timely manner. We therefore recommend that the municipality hire someone in the community to monitor these standpipes and immediately report problems. This will ensure that breakage is addressed more rapidly while instilling a sense of community ownership of the standpipe. It will also encourage the community to take better care of the meter while helping to discourage vandalism.

A subsidization scheme must be developed in conjunction with the metering systems to ensure that everyone has access to water.

The current prepay metering scheme allows the possibility of a user's water to be cut off; when a user runs out of credit on their card, meters will no longer dispense water. More than half of the post-pay users surveyed have experienced this problem. When the people we surveyed ran out of credit, they could only obtain water from family and friends. While this currently appears to ensure that everyone in the communities always has access to water, there is no guarantee that all areas of the

informal settlements will have the same strong communal and family support as the ones we surveyed.

To address the possibility of water cur-off, a tariff scheme should be developed to ensure that residents can always obtain water from the prepay meters. This can be achieved using a free "baseline" policy in which all users are always guaranteed enough water to survive. However, the issue of cost-recovery would need to be addressed in order to institute this policy. The cost of the water supplied for free would need to be subsidized by the City as such expenses are currently being paid by compliant members of the post-pay community. This could be achieved by increasing the price of the penalty block of Windhoek's block tariff water pricing structure. The increase of the block would only need to be minimal as the informal settlements only consume two percent of Windhoek's water.

Another option would be to institute a universal tariff and offer a refund to users consuming a low amount of water. This system would encourage conservation while reducing the cost of water for those whose consumption is already minimal. Affordability of water for the poor could be ensured by setting the refund level at the minimum amount required for sustenance and issuing a complete refund for consumption under this amount. A system using a universal tariff with refund has been established in Rehoboth and could be used as a basis for developing a similar system in Windhoek.

The hours of the point of sale office should be expanded to include weekends.

The point of sale office where people go to purchase water credit for their prepay cards is currently open form 8am to 12pm Monday to Friday. Our surveys indicate that the majority of people who have run out of credit on their card ran out over the weekends and were not able to purchase credit until Monday morning. The point of sale office hours lengthen the time they had to go without being able to purchase water. We recommend that the hours of the POS office be extended to include weekends to allow water credit purchases every day of the week

An alternative solution to this problem would be to institute a "lifeline" policy that would allow users to debit their account if they run out of water credit. This would ensure that users who run out of credit on the weekend are still be able to obtain water from prepay meters. This system could not serve as an alternative to a "baseline" subsidization policy as the amount of debt a user can accumulate on their

account would have to be limited. The ability to accumulate unlimited debt would perhaps encourage abuse of the system, essentially allowing users to obtain free water.

Better maintenance records of the prepay meters should be kept.

A widespread concern about the prepay meters is that they are unreliable and malfunction or break often. Keeping records of problems reported with and maintenance performed on the prepay meters will allow for an ongoing quantitative assessment of the reliability of the prepay meters. This will become more important as the prepay program expands. In addition, as more brands of meters are put into use, it will allow for comparison of the reliability and maintenance costs of each brand. Maintenance records could also be used to provide feedback to prepay meter manufacturers to assist them in the improvement of their design.

Feedback on the success of the prepay program should be obtained from community members on a regular basis.

In order to properly assess the success of the prepay program as well as any problems that may exist, it is important to obtain feedback from the end users of the system. This could be done by installing suggestion boxes at the point of sale offices allowing users to submit written comments. In addition, a stronger relationship with the City's Community Development office could be developed. During their interaction with the community, Community Development officers could ask users for feedback on their experiences with prepayment.

The possibility of using less expensive prepay cards should be investigated.

The current cards used to store water credits cost N$87. This is a significant expense to members of the informal settlements. It is also expensive for the City to purchase replacement cards for users whose cards malfunction. Technology currently exists, such as that in use for payphones in Namibia, which allows a declining balance to be stored on disposable cards. This would greatly reduce the purchase and replacement costs of water credit cards.

CHAPTER 7: CONCLUSION

As the driest country in Sub Saharan Africa, Namibia must manage its water very carefully to sustain this precious resource. The scarcity of water in Windhoek results in extremely high distribution costs, as water must be imported from dams and rivers over 400km away. In order to recover costs to support this distribution system, the city must charge for the water they provide.

Windhoek's informal settlement communities pay the lowest tariff for the water they consume and are not charged the basic fee. However, the current system of post-payment within the majority of informal settlements unequally distributes costs between community members, resulting in extremely high water charges. The frequent occurrence of nonpayment within these communities results in overpayment by a substantial amount of users.

Based on community surveys, interviews with professionals, and cost analysis, we believe that the prepay meter pilot study has been successful and should be expanded to additional communities. Our survey data indicates that community members view prepayment as an improvement to the post-pay system. Most community members recognize the need for payment and would be more willing to pay if given the individual responsibility for regulating their water bill. However, any expansion of the prepay program must be undertaken with caution and existing problems that result in inadequate access to water must first be addressed.

Primarily, the current prepay metering scheme allows the possibility of a user's water supply to be cut off; when a user runs out of credit on their card, meters will no longer dispense water. Over half of the prepay users surveyed have experienced this problem, proving its severity. To address the possibility of water cut-off, a pricing scheme should be developed to ensure that residents can always obtain water from the prepay meters. This can be achieved instituting a "lifeline" policy which would allow residents to debit their account if they run out of water.

In addition, there is strong concern within the settlements for people who truly cannot afford to pay for the water they consume. With the prepay system, if an individual cannot afford to pay they will not be able to access any water. This problem could be addressed through the design of a free "baseline" policy in which all users are given enough water to survive. The subsidization necessary to achieve cost

recovery with such a system could be achieved by increasing the penalty block of Windhoek's block tariff water pricing structure. This price increase would only need to be minimal as the informal settlements only consume two percent of Windhoek's water.

In conclusion, prepay metering has proven to be a successful method of addressing nonpayment and ensuring revenue collection. However, the current system poses the significant but addressable risk that those who cannot afford water will not have access to it. In order to ensure that no one is denied their human right to water, the city must carefully balance its need for collection of revenue with its responsibility to provide water to all.

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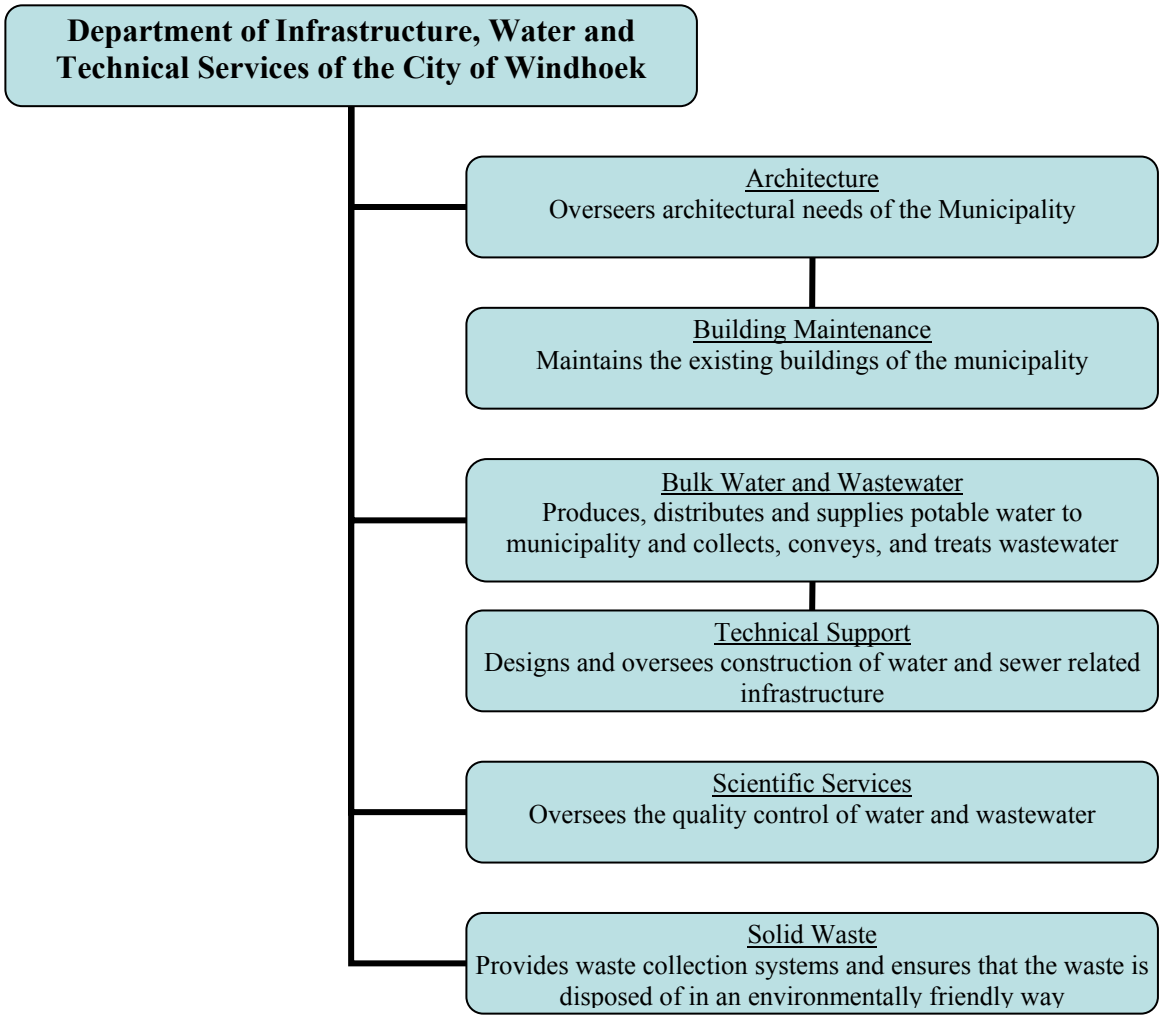
APPENDIX A: DEPARTMENT OF INFRASTRUCTURE, WATER, AND TECHNICAL SERVICES

The Department of Infrastructure, Water and Technical Services of the City of Windhoek is responsible for treating bulk water supplied from NamWater along with water from the city's own complementary sources through networks and reservoirs to distribute to the people of Windhoek.

Although NamWater carries the mandate to supply water to municipalities and private customers in all of Namibia, Windhoek has its own complementary water sources. Water retrieved from boreholes can cover 20% percent of the city's needs in times of emergency, and supply approximately 4% of the city's water on a daily basis. In addition, Winhoek's reclamation plant provides 35% of the city's water when running.

The Department of Infrastructure, Water and Technical Services is comprised of six divisions. The Division of Architecture oversees architectural needs of the municipality and works with the Division of Building Maintenance which maintains the existing buildings of the municipality. The Department of Bulk Water and Wastewater provides semi-purified water for irrigation, produces, distributes, and supplies potable water to municipalities. It also serves to collect, convey, and treat wastewater. The Division of Technical Support designs and oversees the construction of all water related and sewer related infrastructure. The Division of Scientific Services oversees the quality control of water and wastewater and is responsible for the prevention of water-borne diseases. Lastly, the Division of Solid Waste deals with all solid waste in the city through collection and environmentally sound elimination of natural waste.



The Department is responsible for maintaining the water supply system up to the water meters situated near the consumer. Responsibility for the water downstream of these meters is placed on the consumer. These meters are used by the department to keep records of how much water is used by each consumer; information that is then analyzed and used to improve the efficiency of the system. However, in less wealthy areas the municipality has installed standpipes and other communal sources where numerous families can collect water.

All six divisions of the department play a role in ensuring the health of its consumers. The reservoirs are monitored on a daily basis and the Scientific Services Division tests and analyzes the water when unacceptable chlorine levels are detected. The Solid Waste Division guarantees the sanitation of the city and plays a key role in sustaining the system through water treatment. Under a discharge permit from the Ministry of Agriculture, Water and Rural Development, The Solid Waste Division sets the standard for treating the water at an acceptable level and deciding before

releasing it back into the municipal system. In other words, the Division is responsible for ensuring that industry in the city meets the standard for water treatment before releasing water back into the sewerage system. If the industry fails to do onsite treatments they will be financially penalized for the burden they place on the municipal sewer system.

The Department of Infrastructure, Water, and Technical Services is responsible for maintaining the drainage system that runs from the main line to the consumer's connection point. This involves maintaining more than 42,000 water connections, 1,200 km of water pipes, and 960 km of sewerage lines. Beyond this point it is the responsibility of the consumer to maintain the system.

APPENDIX B: WHAT IS AN IQP?

An Interdisciplinary Qualifying Project (IQP) unites science and technology with the social sciences and humanities. The purpose of the project is to help students understand the effects that their future careers in technology will have on society. Often in an IQP, students work outside of their field of study to meet the challenges and demands of the project and thereby gain real-life experience.

This water management project qualifies as an IQP in the way that it combines science and technology with social science; its science and technology aspect examines different metering options and possible water pricing policies. It satisfies its social science requirement in that takes into account the reactions and feelings of the community to different water schemes, while examining the right to free water.

APPENDIX C: LEGISLATIVE INTSTITUTIONS AND NAMIBIAN WATER LEGISLATION

The Department of Water Affairs is part of the Ministry of Agriculture, Water and Rural Development, and is made up of two directorates: the Directorate of Resource Management and the Directorate of Rural Water Supply. The Directorate of Resource Management is responsible for management, planning, control, and guardianship of the water sector, while the Directorate of Rural Water Supply is responsible for providing clean, safe water to Namibians. The objectives of the ministry are outlined in the Water and Sanitation Policy of 1993. These objectives include ensuring the availability, accessibility, and affordability of water to all Namibians and stress the importance of government and community co-operation in water management (http://www.op.gov.na/Decade_peace/agri.htm).

In 1998, control of bulk water supply was transferred to the parastatal (see Glossary) Namibia Water Corporation (NamWater) as an extension of the NamWater Act of 1997. Initially state control of groundwater was established in 1971 by the South African government, the controlling power at the time. Under this legislation, all rivers were classified as public water and required an abstraction permit. Namibians were prohibited to sink, deepen, or alter a borehole without a permit (Namibia Resource Consultants, 2001). The NamWater Act of 1997 stresses that the supply of bulk water must be high in quality, sufficient in quantity, affordable, cost effective, environmentally sound, and achieved through sustainable means. The Act also specifies that NamWater is responsible for rendering water related services, supplying facilities, and granting rights to consumers. The major aspects of the NamWater Act stipulate that the corporation must be managed on a full cost recovery basis including operation, maintenance and capital costs. This allows NamWater to base its tariffs on a full cost recovery basis (http://www.namwater.com.na).

Namibian water policy had been based upon Water Act 54 of 1956 until the Water Resources Management Act was passed by Parliament in 2004. Water Act 54 of 1956 was based on the old South African Water Law, which did not consider principles of social equity or environmental sustainability. The legislation can be traced back to policy created in Europe where water is readily available, making it inconsistent with Namibia's post-independence economic and social situation as well

as its climate. Many amendments were made to the water policy in an attempt to better address the social concerns of those of lower economic status. These included the Water Supply Sanitation Policy of 1993, the National Policy White Paper of 2000, and the Water Resources Management Bill of 2002. However, the need for a core policy was not recognized until 2003 with the creation of the Namibia Water Resources Management Review Project.

The Water and Sanitation Policy of 1993 outlines the objectives of the Department of Water Affairs (DWA) and stresses the importance of government and community co-operation in water management. The Policy strives to ensure the availability, accessibility, and affordability of water to all Namibians. (http://www.op.gov.na/Decade_peace/agri.htm).

In 2000, the National Policy Whitepaper was passed establishing the principle that management of water resources must take into consideration the human need for water along with environmental considerations. This was the first legislative recognition of the role of water in supporting Namibia's ecosystem (Amakali et al. 2002).

The Namibia Water Resources Management Review Project, established in 2003, is currently working in conjunction with the DWA to create water basin management areas (Amakaliet , 2002). The management of all water affairs will be made in conjunction with the water committees from each of these areas, depicted in Figure 21, with the goal of empowering communities to take responsibility for their water issues
(http://www.dea.met.gov.na/met/programmes/eia/eiaagriculture/AgrB.pdf).

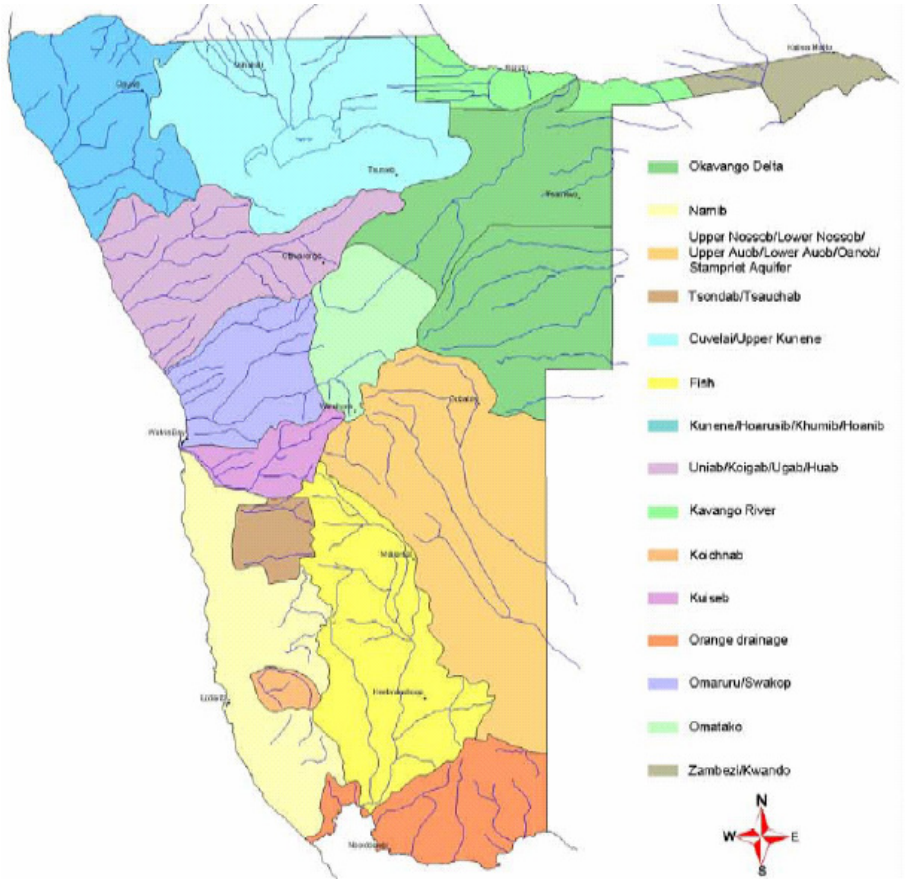


Figure 21: Water Basin Management Areas

The Water Resources Management Act of 2004 reflects the impact of the Review Project as it incorporates basin management into the core water policy. The act was designed to

> …provide for the management, development, protection, conservation, and use of water resources; to establish the Water Advisory Council, the Water Regulatory Board and the Water Tribunal; and to provide for incidental matters.

Within the last decade, a number of bills and acts have been passed that provide for new institutional measures at all levels. However, these policies are not always made in conjunction with the communities that they are designed to help. When people are encouraged to participate in the defining of problems and proposal of solutions, they are more likely to actively contribute to the success of these solution paths. Moreover, communities will be less likely to resent the policy changes if they are adequately informed of the reasoning for the decision (Matros, 2002).

APPENDIX D: COMMERCIAL WATER USERS

Agriculture is the largest single user of water in Namibia. Since the soil is very dry and evaporation rates are high, large volumes of water are needed to irrigate crops. Aside from irrigation, approximately one quarter of the water used for agriculture is used for raising livestock.

The mining industry also uses a significant amount of water, most of which is potable river and aquifer water that would be otherwise fit for human consumption (WISE, 1997). Recent improvements in mining processes allow water to be used very efficiently; however, it would be much more environmentally sound to design legislation that encourages mining operations to use semi-purified water.

APPENDIX E: INTERVIEWS

INTERVIEW WITH ANNA MATROS

4/1/05

4:00 pm

- DRFN's focus before independence: Biological
    - after independence
        - agricultural management w/ farmers
            - distribution of land & how it affects environment
        - water
        - energy management
- IWRM originated from the Global Water Partnership
    - IWRM is based on the Dublin Principals
- The Global Water Partnership came to Namibia to promote IWRM in 2001
    - Worked on a project for piloted country partnership in different countries
    - the DRFN was their contact
    - the DRFN established a network by creating the Namibia Water Partnership
        - the DRFN is the secretariat
        - ~20 ministries are involved as well as
        - They have looked at the UN's Millennium Development Goals
        - Work began last year on water efficiency guidelines
        - They are currently working on an integrated water efficiency plan
            - A draft version exists but hasn't been approved by the partners
        - The DRFN's focus is more rural than urban
        - Ferdi Brinkman is part of the partnership
- The Environmental Structure Plan for the City of Windhoek was created
    - Included an urban survey
        - Topics were mostly environmental
        - Some topics dealt with water
    - Part of the project was the creation of a hydrology map
- We should ask Urban Dynamics for their reports

- NamWater is launching a campaign to educate people on why they should pay for water provision
    - They created a report
- The current national water act is the 11th revision
    - There is documentation of the review process
- Namibia Water Management Review reports are in the DRFN library
- Complaints with pre-pay from community that Anna has heard:
    - Tags always broken
    - Leakage
    - Wasted water
    - Broken taps
    - People don't realize that their water can be cut off – they just think prepay is the cheaper option
        - Anna thinks pre-pay is more expensive for consumers
        - Anna has heard that people will steal water from people's houses when they run out of water
- Anna thinks a pre-pay lifeline system would not work
    - the subsidization scheme that would be necessary to support it would not work – like in SA
- Anna thinks the current block tariff system in Windhoek works & is good
- We asked about a possible block tarrif system where the bottom block is free
    - Anna said it would be a burden on the upper class and would not be fair
    - Like in SA, someone will have to pay for that "basic amount"
- Anna says she doesn't understand her water bill
- We can get information about water billing in the metropolitan area at the front of municipality building where Pete is sitting
- The municipality gives waste collection to informal settlements
- Water point comities exist in rural areas and are managed by the Rural Water Supply Division of the Ministry of Water, Agriculture and Forestry
        - Water points are constructed if there is a minimum population
        - People elect an 8 person committee who gets trained by Rural Water Supply

        - Water point committees are responsible for minimal maintenance such as buying the diesel for the pump (Rural Water Supply fixes major problems with the water supply equipment)
        - They do not get paid
        - Anna thinks they would be much more successful if they were paid
    - Water charges:
        - Houses are often charged a fixed fee for the diesel
        - People are charged by amount of water usage
        - People are charged per cattle (20 cents per head)
        - Watering Point Committees pay monthly to NamWater if they are on a NamWater branch line
    - People aren't charged for unaccounted for water (leakage)
    - Most rural communities are on NamWater's pipes in the north
    - Most communities in the south have boreholes
    - Some people don't want to pay and get water from open pools
        - People often get sick from this
        - There are many cultural issues involved
    - Anna says NamWater should collect payments rather than having people come to them
    - The Water and Sanitation Policy (WaSP) explains water point committee responsibilities
    - The Ministry of Water, Agriculture and Forestry - Rural Water Supply Division wants water point committees to perform major maintenance by 2007
- We asked about possibly creating water point committee (WPC) in the informal settlements
    - Paid positions for community members
    - Ministry of Agriculture and Water Supply wants WPC to do more maintenance
- A Water Conference was held last year at the Safari Hotel at which Anna's masters thesis, Linking Policies to People was presented

INTERVIEW WITH BEN VAN DER MERWE

4/6/05

2:00 pm

- Used to work for the Water Sector before they combined it
- Approved on-site prepay 2-3 years ago - Individual connection
- 1,200 connections in Rehoboth
    - water sales from these meters were very low
    - Problems -
        - Pay for water and then they would have bill of $50
        - Battery would fail
        - Just got stuck
    - Sued manufacturer for installing new meters that did not work
- Nossob – N$ 2500 per meter with a very high maintenance cost
    - ($250 per normal meter)
- Doesn't pay for cost to fix & maintain
- In Rehoboth a conventional meter was installed in front of a prepay meter and readings did not match up
- Water sales are approximately 10% of usage for house connections
- Other costs built into pre-pay costs
- Electronic and gets very hot – heats up electronics
- Most meters were built as prototypes, and then used in the field
- Communal standpipe prepay works well
- Including other services in price of water (sanitation)
- Swakopmund – water was cut off & people took water from nearby cemetery & got very sick
- In Windhoek average person uses 14L/person/day in Windhoek
- 2.1% of total water consumption is in the informal settlements
    - charging the poor for such a small amount
- 27% use less than $15m^3$ / month 100L/person/day
- 30% use less than $15m^3$ in Windhoek
- Early in the 80's the more water you used the cheaper it was
- Water consumption directly related to income
- Low income in Windhoek: 2 flushed/day

- High income in Windhoek: 5 flushes/day
- Up to 1990's no informal settlements so houses were very overcrowded to compensate
- Tariff system – block tariffs reduced high income consumption
    - Sewage tariff system designed in the 80's, very outdated
    - Basic charge
        - Give rebate if only using less than 15L
            - Need to read meters regularly
    - Cost of cutting water is a huge problem and very irresponsible
        - People die in house fires when water is not available
- Rehoboth
    - No credit control
    - Developed system
        - If people don't pay, let accounts run, cut off water, everyone suffers
        - Cost recovery was 50% NamWater received $8million
    - Tariff system – credit
        - Created loan account w/ municipality so $ is not owed to Namwater
        - Accounts went way down – NamWater received $1.5million
    - Credit Control
        - Trickle flow activated if water bill was not paid after one month
        - 6-10 m^3 per month
        - 1 min to fill cup of water
    - People started to repay, and there was a record amount of money collected
    - Problems
        - People lost trust in municipality
        - Windhoek is very expensive
        - Tariffs are very high
- Windhoek
    - Baseline – restructured tariffs w/ subsidization would be possible
    - Rebate – for people who use less than 15m^3 per month

    - Unlimited free water not practical as people will start gardens
    - $3m^3$ per month for family per month for water
- Sida – training plumber to look after maintenance of pipes
    - Ran over 2 years
    - Men sent to Windhoek & attended two courses
    - Plumbers charge $200/hr & large fees
    - In some homes the leakages were very high
- Rehoboth
    - Hired people from the community to maintain & monitor meters
    - worked 1- weeks per month fixing meters & credit control
    - paid them $500/month
    - after training they must work on their own as private contractors but they were to reliant on municipality
    - were told to stand on own two feet, but only wanted to work for municipality
    - they were then trained in business skills, ect.
- Boreholes
    - Natural $1.7Mm^3$ per year for 10 years to recharge the Windhoek borehole
    - If you inject $10Mm^3$ per year it will only take two years
- NamWater – government recognized that they would not be able to provide water
    - Must have rebate not lower tariff
    - Must qualify by using less water
    - Could also do it as a block tariff
    - Rebates are automatically given by municipality

INTERVIEW WITH PIET DU PISANI

4/12/05

2:30 pm

- Sanitation in informal settlement is poor
    - At present they are not able to provide informal dwellers with the appropriate sanitation

- To provide adequate sanitation, the system must be financially sustainable
- In order to provide service, need to prove that people can afford it.
- It is necessary to start calculating the environmental cost.
- Currently the City divides the areas into 5 different sanitation levels (0 -5)
    - Level 0 needs to have standpipes within 75 m
- Currently they ask for N$5 for sanitation
- Cannot provide sanitation for $1 day. Currently asking for N$30 for sanitation, wash removal, and water.
- City has two plumbers for 500+ toilets
- They have considered assigning 20 people to a toilet.
- Some informal settlements have "skip containers" (approximately 300 of them) for refuse.
    - Unemployed community members keep an eye on trash; makes sure correct waste is deposited. It costs approximately N$250 – 300 a month.
- Ferdi- City trained plumbers once, but they moved out of commercial communities to get real job
- Says it is possible to put community in charge of maintaining facilities
- If the City pays for and repairs broken facilities, they will break again
- Once community is in charge of the facilities they will break less
- Now promoting idea that if you rent land you will not be paying for sanitation

- Payment systems
    - Have not yet gone full throttle with the prepay because hardware is not as robust enough
    - With yard connection you still have to pay a monthly charge to cover the capital cost. It's a volumetric tariff
    - It might be possible to "network" credit (like AVM prepay electricity). Currently it is not networked, it is only in two stations
    - Free baseline
        - It is very difficult to draw the line for the free baseline

        - Currently
            - 0 -6 m^3 is subsidized
            - 6 -45 m^3 operational cost recovery
            - 45+ is a penal tariff→ N$14/ m^3
    - Industry pays approximately N$8 per m^3. This is the cost recovery tariff + some capital costs.
    - Prepay meters are bought locally
        - If parts break they need the local support
    - They have looked at all meters on the market
- Universal tariff with rebate
    - Difficult in informal settlements because there is mostly no individual metering
- Community interaction
    - Community development is supposed to identify needs of communities. If the need is tangible, community development reports to appropriate department.
    - Complaint facilitated by meetings facilitated by meetings once a quarter. Entire community is invited and city councilors.
    - Piet feels this does not give an accurate picture of problem
    - Planning people actually have to interact when a need is being addressed
    - City can not afford to provide services free of charge – all costs need to be recovered somehow.
- Subsidization
    - Socially needy is responsibility of the government.
    - Government does not accept the responsibility of taking care of the poor, so responsibility falls on the local government
    - Local governments cannot afford the responsibility of caring for the socially needy.
    - The poorer people who use less water pay more per volume, than higher volume users because the basic charge has a larger impact on the poor.
    - Have identified a need for a new subsidization system. However, no action has been taken.

- Idea of getting subsidy from industry. Do not want to burden industry however, because it provides jobs.
- No subsidization currently with electricity. Everyone pays the same amount for a kilowatt-hour.
- With electricity you are allowed to make a profit- Not so with water and sewers. It must be priced at cost recovery or below.
- Currently tax system is based upon property value

APPENDIX F: COMMUNITY MEMBERS INTERVIEW QUESTIONS – KEY

Interviewer:

1. Jackie
2. Anne
3. Mike
4. Paul

Translator:

1. Dennis
2. Ngula
3. George
4. None

Language

1. Oshiwambo
2. Otjiherero
3. Damara
4. English
5. Afrikaans
6. English and Oshiwambo
7. English and Otjiherero
8. Oshiwambo and Otjihereri

Location:

1. Africa Tongashili
2. Havana No 1, 2
3. Havana Ext 2-5
4. Okuryangava- Erven 23276 and 2327

Gender:

1. Male
2. Female

General

1. When did you come to the City?
    1. Less than a year
    2. 1-2 years
    3. 2-5 years
    4. 6-10 years
    5. 10+ years
2. Where do you originate from?
    1. Rural area
    2. Other informal settlement
    3. Other _____
3. Did you pay for water before you lived in the City?
    1. Yes
    2. No
4. How many people live in your household?
    1. 1-3
    2. 4-6
    3. 7-9
    4. 10+
5. Which of the following do you have?
    1. Car
    2. Electricity
    3. Car and electricity
    4. Neither

Economics

6. What is your employment status?
    1. Employed
    2. Self-employed
    3. Unemployed
    4. Learner or Student

7. If employed, what is you job title?

_____

_____

_____

8. If you are employed, how long have you held your current job?
    1. Less than 1 yr.
    2. 1-3 yrs.
    3. 3-5 yrs.
    4. Greater than 5 yrs.

9. What is your household's approximate monthly income?
    1. No answer
    2. Under 200
    3. 201- 500
    4. 501- 1000
    5. 1001- 1500
    6. 1501+
    7. 0

10. Do you pay for the water you consume?
    1. Yes
    2. No

11. If yes, how much do you pay for water monthly?
    1. 10 or less
    2. 11- 30
    3. 31- 50
    4. 50+

12. How do you pay for water?
    1. Prepayment
    2. Post-payment

3. Other _____

General Payment

13. How do you feel about having to pay for water?
    1. should be free
    2. Payment is necessary
    3. Other _____

14. What problems do people have with paying for water?

    Prepay Communities
    1. Water is expensive
    2. Problem with system
    3. None
    4. Other

    Post-pay Communities
    1. Water is expensive
    2. Others not paying
    3. None
    4. Other

15. Do you think water is too expensive?
    1. Yes
    2. No
    3. No opinion

16. If yes, what would be a reasonable price?

_____

_____

_____

17. How far away is your closest functioning water point?

_____

_____

_____

18. How often do you have to wait in a queue to get water?
    1. Never
    2. Rarely
    3. Half the time
    4. Often
    5. Always

Prepay Users (complete if question 11 is answered 'Prepayment')

19. How often do you need to purchase water credit?

_____

_____

_____

20. Do you have problems with the times at which you can purchase water credit?
    1. Yes
    2. No

21. If yes, which of these times would be most convenient to purchase water credit?
    1. Weekends
    2. Weekday Mornings
    3. Weekday Nights
    4. Weekday Midday
    5. Other _____

22. Do you ever run out of credit and become unable to get water?
    1. Yes
    2. No

23. If yes, for how long?

_____

_____

_____

24. If yes, how often does this happen?

_____

_____

_____

25. If yes, where do you go for water?

1. N/A
2. Friends, neighbors, etc.
3. Non-prepay standpipes (different communities)
4. Other _____

26. Is there anything specific you like about the prepay system?

_____

_____

_____

27. What are some problems or grievances you have with prepayment?

_____

_____

_____

28. What do you think might be a possible solution to these problems?

_____

_____

_____

Post-pay users (complete if question 11 is answered 'Post-pay')

29. What are your feelings towards those who do not pay for water?

_____

_____

_____

30. Should there be a penalty/consequence for those who do not pay for water

1. Yes

2. No
3. Don't know

31. If yes, what kind?

_____

_____

_____

32. If no, why not?

_____

_____

_____

33. Do you know about prepayment water metering?
    1. Yes
    2. No

34. What are your feelings towards prepayment?

_____

_____

_____

Maintenance

35. Do you ever have problems with facilities (such as standpipes, toilets, or meters)?
    1. Yes
    2. No
    3. Don't know

    35a)
    1. Toilets
    2. Watering point
    3. Both
    4. Other

36. If yes, what were the causes?
    1. Vandalism
    2. Misuse
    3. Closure
    4. Other

37. If yes, how long until the problems were addressed?

_____

_____

_____

38. What do you think could be done to improve the maintenance of the facilities?

_____

_____

_____

Water Sources

39. Why do you think the City sells water?
    1. Knows why the City sells water
    2. Know somewhat why City sells water
    3. Does not know why City sells water
40. Where do you think the water you receive comes from?
    1. Knows where
    2. Knows somewhat where
    3. Does not know where

41. Do you feel that it is necessary to conserve water?
    1. Yes
    2. No

42. If yes, why do you think so?
    1. Water is scarce
    2. Water is expensive
    3. Water is life, you need it

4. Other

43. Is there anything else you would like to comment on regarding water issues?

_____

_____

_____

Thank you very much for your time and responses!

APPENDIX G: INTERVIEW QUESTIONS FOR LEADERS

This appendix shows the questionnaire used to interview the community leaders as well as the responses they gave us.

Draft 3 – March 29th, 2005

Serial #: _____	Date: _____
	Translator(s): _____
Interviewer: J A M P	Language: _____

Location Key:

HM(1) –Havana (post- payment) no. 1&2 (leader 1)

HM(2) – Havana (post- payment) no. 1&2 (leader 2)

HPre – Havana (prepayment) ext. 2-5 (leader 1)

Oku – Okuryangava erven 2326 & 2327

Gender:

HM(1) – M and F

HM(2) – F

HPre – F

Oku – M

General

44. How long have you led this community?

HM(1) –3 years

HM(2) –13 years

HPre – 3 years

Oku – Since 2002, 3 years

45. Approximately how many households are in this community?

HM(1) – There are 50 households per a block, but I have no idea how many households are in a section

HM(2) – 1,300- 1,400. This is only for Havana 2.

HPre – 80 -83

Oku – They are in groups with approximately 30 households per a group

General Water Payment

46. What water payment system do you use?
    - Prepayment
    - Post-payment
    - Do not know

HM(1) – Post-payment

HM(2) –Post-payment

HP – Prepayment

Oku – Prepayment

47. What problems do people have with paying for water?

HM(1) – Most people are unemployed and cannot afford to pay. How many people do not pay? *Most people do not pay. Only a few are able to.* How do you feel about payment? *I do not feel good about it. The amount we are paying now is not what they originally asked us to pay. It jumped from N$ 50 to N$ 85, due to the construction of toilets and electricity.*

HM(2) – Some people do not work. Some do not have money to pay. How do you feel about water payment? *Water payment is not okay because we cannot afford to send kids to school.* How do you feel about the current price? *It is expensive, kids need to go o school.* What is a fair price? *Even N$ 40 is fair When they organized a meeting they agreed to a maximum of N$ 50, now they are paying N$ 85.*

HPre – No problem

Oku – No complaints

48. How many standpipes are in your community?

HM(1) – 8 in whole, one standpipe for each block. Why is one standpipe locked? *Standpipes are open all day, and we close it in the evening. There are two toilets in each block, one for the males and one for the females.*

HM(2) – 80 standpipes

HPre – 8

Oku – I know about 8 for the entire community

Post-payment (complete if question 3 is answered 'Post-payment')

49. How is money collected for the monthly bill?

*HM(1) – Each person gets a receipt and they take the money to the municipality(*does not go to the leaders). *Municipality goes to specific person.*

*HM(2) – Community pays municipality directly (*see above).

50. What problems do you see with this system, if any?

HM(1) – No problems with the system

HM(2) – Some taps do not give water, and others are slow.

51. How is failure and/or reluctance to pay dealt with?

HM(1) – Municipality deals straight with people who do not pay

HM(2) – Some people do not think to go to the municipality to pay for water. Municipality takes receipts and says who is not paying

52. Should there be a penalty/consequence for those who do not pay for water

- Yes
- No
- Don't know

HM(1) – Municipality suggests

HM(2) – Municipality asks leaders to talk to people

53. If yes, what kind?

HM(1) – No response

HM(2) – No response

54. If no, why not?

HM(1) – No response

HM(2) – No response

55. Do you know about prepayment water metering?

- Yes
- No

HM(1) – No

HM(2) – Yes

56. What are your feelings towards prepayment?

HM(1) – We want the meters but they told us since they have savings groups it will be hard to install them. If they were to put the meters in, would people have problem paying? *No you can recharge with whatever money they have, it's a nice idea.*

HM(2) – No response

Prepayment (complete if question 3 is answered 'Prepayment')

57. How long have you been using prepayment?

HPre – Since 2000

Oku – Since 2000

58. What are your feelings towards prepayment?

HPre – Good even for those who do not work can pay just what he has (N$ 5 or whatever) to get by.

Oku – I like the system, it is effective, can recharge anytime.

59. What problems do you see with this system, if any?

HPre – When someone looses a card, they have to pay for another card and it is very expensive.

Oku – Sometimes you know you have credit but the meter wont dispense

60. What do you think might be a possible solution to these problems?

HPre – They want electricity, fire brigade, phone booths etc, want municipality to bring these things.
Oku – They have a system in which the leaders report problems to the municipality and they usually get fixed in good time.

61. What are some of the benefits you see with the prepay system, if any?

HPre – It's a good system.
Oku – It's a good system.

Maintenance

62. Do you ever have problems with facilities (such as standpipes, toilets, or meters)?
    - Yes
    - No
    - Don't know

HM(1) – Yes. Sometimes the toilets do not work. They have locked them. Most people have keys, but those who do not have to find someone who does. The toilets do not always flush and it was a long time before it was repaired.
HM(2) – Yes. Some toilets do not pump water, the joint of the pipe is blocked. Thee told the municipality but it was not fixed. Who reported it and to what Department?
They reported it to the Community Development workers. It takes about a months time to repair leaky pipes.
HPre – Yes, standpipes are broken and run too fast. Toilets are out of order. Community members report to leaders when something is broken.
Oku – Yes, when standpipe is broken it sometimes erases credit. Toilets have been broken for about a year; it was broken because of vandalism. We have to go and us toilets that are farther away. Toilets are not flushing.

63. If yes, what were the causes?

HM(1) – No response
HM(2) – No response

HPre – People come and take parts from the toilets such as tanks and handles. It is theft.
Oku – Vandalism by outsiders.

64. If yes, how long until the problems were addressed?

HM(1) – Broken pipes took municipality four months to fix and it cost them a lot of money. Who reported the problem? *The company that constructed the toilet comes ans fixes it. We call the municipality and they call the company.*
HM(2) – One month.
HPre – Have told the municipality about the problems since 2001. Toilets have not been fixed.
Oku – Municipality gave up. They used to come fix things but they haven't now.

65. What do you think could be done to improve the maintenance of the facilities?

HM(1) – We want faster responses to broken pipes etc.
HM(2) – No response
HPre –There are enough standpipes. Some people cannot or just do not pay for water so they steal it from the toilets. Municipality said they would fix the toilet doors and give keys out but it has not happened.
Oku – We want municipality to come fix the toilets. We can manage it with locks and keys, and we can clean them ourselves, but we need doors first.

66. Who should be responsible for maintaining the facilities

- Community
- Municipality
- Do not know

HM(1) –Community
HM(2) – Community. Municipality says that if there are problems they should fix them. They are trying to collect money to repair them. What if a community monitor was hired in the community? *The municipality already said they would provide this and they have not.*
HPre – Municipality
Oku – Municipality fixes it, community will maintain it.

67. Is vandalism a problem?

HM(1) – Vandalism is in other communities but not here.

HM(2) –Toilets are being broken, parts are being stolen. Standpipes used to be vandalized but now they are being closed up with iron.

HPre – No response

Oku- Yes. See previous responses

68. How is vandalism addressed?

HM(1) – No response

HM(2) – No response

HPre – No response

Oku – No response

69. Who is responsible for vandalism?

HM(1) – No response

HM(2) – I do not know. It could be happening at night. People could be building their own toilets, so they steal parts from ours. A community watch would be helpful.

HPre – No response

Oku – Usually when council has meetings or when leaders go back to their rural areas, things get stolen. It is hard to keep your eye on the facilities during these times

Water Sources

70. Do you think your community understands why there is a cost to provide water?

HM(1) – They have an understanding of why they have to pay, but not the amount they are paying.

HM(2) – They know that they need this water for drinking and cooking. They do not understand that they are paying for the pipes to provide the water.

HPre – Yes

Oku – Yes, I believe they understand because they do not complain.

71. Do you think it would be beneficial to educate the community about where their water comes from and why it costs money to provide it?

HM(1) – I believe that there is a need to educate. Most people know, ut the amount of money they are paying is too high compared to other communities.

HM(2) – They told the community that they have to pay for the pipes and that everything costs money.

HPre – Yes, on Saturday they want to have a meeting to tell the community about the cost of providing water.
Oku – Maybe. The City has not told the community members. I know the basics from meetings with councilors.

APPENDIX H: PREPAY METER INVOICE SUMMARIES

Year	Month	Day	Type	Qty	Unit Price	Total Price
2003	2	19	Plungers	10	$18.98	$189.80
2003	2	20	Solenoids	10	$138.00	$1,380.00
2003	2	24	Solenoid Valves	4	$72.20	$288.80
2003	2	24	Valves	4	$340.11	$1,360.44
2003	2	24	Pulse Wires	4	$62.79	$251.16
2003	2	24	Valves	4	$295.75	$1,183.00
2003	7	23	Closer Asbly - Bernard Valve	5	$124.33	$621.65
2003	7	23	Plungers	5	$18.53	$92.65
2003	7	23	Pulse Wires	2	$72.21	$144.42
2003	12	17	Pulse Wires	3	$62.75	$188.25
2003	12	17	Solenoids	10	$120.00	$1,200.00
2003	12	17	Token Slots	5	$20.95	$104.75
2003	12	17	Closer Asbly - Bernard Valve	7	$108.11	$756.77
2004	1	19	PC Boards	4	$339.78	$1,359.12
2004	3	29	PC Boards	5	$339.78	$1,698.90
2004	3	29	Token Slots	10	$20.95	$209.50
2004	10	15	PC Boards	10	$339.78	$3,397.80
2004	10	15	Token Slots	10	$20.95	$209.50
2004	10	15	Plungers	10	$16.47	$164.70
2004	10	27	PC Boards	10	$339.78	$3,397.80
2004	10	27	Token Slots	10	$20.95	$209.50
2004	10	28	Plungers	10	$16.47	$164.70
2004	11	18	Closer Asbly - Bernard Valve	5	$108.11	$540.55
					Total:	**$19,113.76**

Table 7: Replacement Parts Purchased

Type	Total Qty
Closer Asbly - Bernard Valve	17
PC Boards	29
Plungers	35
Pulse Wires	9
Solenoid Valves	4
Solenoids	20
Token Slots	35
Valves	8
Total:	**157**

Table 8: Count of Replacement Parts Purchased

APPENDIX I: CONTACT INFORMATION

Name	Title	Numbers	Email	How We Met & When
Ferdinand Brinkman	Chief Engineer: Bulk Water & Waste Water	+ 264 61 290 2345(O) + 264 61 212 777 (H) 081 124 5801 (cell)	fbr@windhoekcc.org.na	Liason – March 14th
Mbahupu H. Tjivikua	Coordinater Namibia Project Center - Poly	+ 264 61 207 2074	mtjivikua@polytechnic.edu.na	
Bland Addison	Advisor	207 2700		
Mack Geiseb	Wingoc	272138 (O) 0812620234(cell)		Tour of Goreangab March 15th
George Samueis	Community Development	290 2793 (O) 081 2469359 (cell)		Talked to us about payment collection March 16th
Frank Carew	Bulk Water – Prepayment Meters	290 2419 (o)		Through John to take us through settlements March 15th
John Esterhuizen	Bulk Water - Water Management	290 2339 (o)		Through Brinkman to work March 14th
Mr. Benjamin Alcuck	Community Development	290-2702		March 16th
Mike Kalua	Community Leader - Africa Tongashili			March 16th

Bertus Kruger	DRFN			March 22nd, DRFN survey workshop
Alex Verlinden	DRFN			March 22nd, DRFN survey workshop
Erik Dirks	Natl. Planning Commission	283 4111(switchboard)		March 22nd, DRFN (snowball)
Piet du Pisani	City of Windhoek (office?)	290 2338		March 22nd, DRFN (snowball)
	Urban Dynamics	228 435		
	National Housing Enterprise	292 7111		
Mr. Hangula	Head of Central Beurau of Statistics	283 4063		
Ms. Hieke Von Alvensleben	Sustainable Development (co-ordinator of informal settlements)	290 2048		
Harold Kistings	Sustainable Development	290 2376		Mrs. Von Alvensleben
Barend Lottering	Elster Kent	(cell) 081 127 2420		
Ryan Steynberg	Bulk water- project implementation	290 2014		
Taipope	CEO of Windhoek	290 2618		Frank
Martin Shikongo	Mayor of Windhoek	290 220 (cell) 0811 240331		Frank
Enginine !Owos-oas	Sr. Development Officer	081 29 44970		
Ben Van Der Merwe	Private Water Consultant - Africon	0811 282469		
Jefta Goreseb	City of Windhoek	290 2035	jgo@windhoekcc.org.na	IWRM presentation

Evelyn Limba	Legal Assistance Centre	061 223356 (cell) 0811288805	Elimba@lac.org.na	IWRM presentation
Anna Matroz	DRFN	377 500		IWRM presentation
Ingeborg	DRFN	377 500		
Claire M.	DRFN (translators)	081 256 5218		
Ngula Niipele	Translator	081 24 61686		Claire
Dennis Tjiueza	Translator	081 29 51682		Claire
George Kozonguizi (290) 2371	Resigned from Environmental Division – now working for NDP	290 2371		